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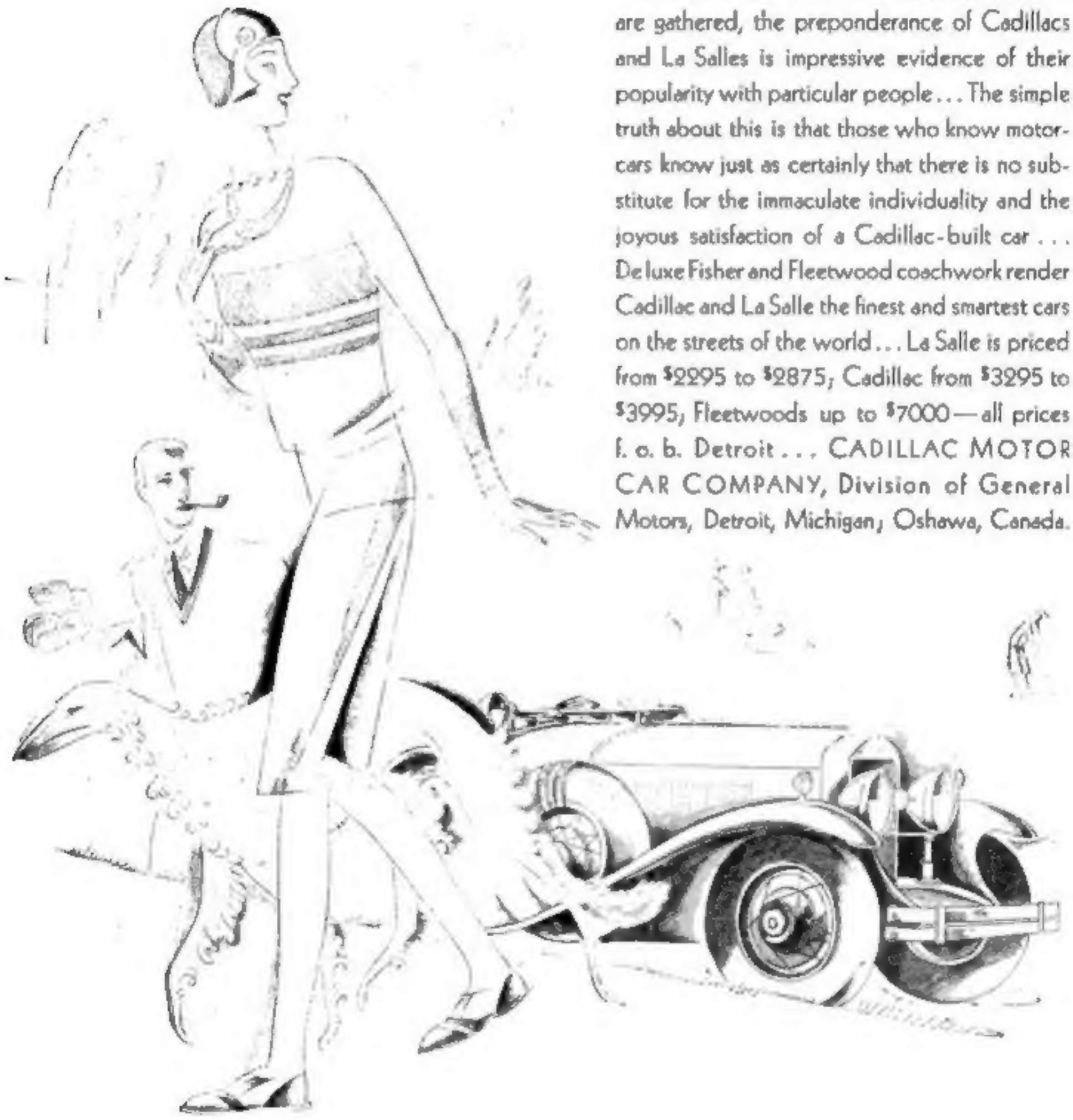

CADILLAC · LA SALLE

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In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

Pinning TAILS ON DONKEYS

By WALLACE AMES, *Financial Editor*

In last month's issue we published the account of a party given by Gary Clark at which the efforts of his friends to get rich quick through stock speculation were likened to the blindfold game of pinning tails on a donkey. Gary's friends, willing to admit the faultiness of their stock market dabblings, expressed interest in a sounder procedure and another meeting was arranged to continue their discussions.

* * *

"At our last gathering," began Gary Clark, "I admitted buying stocks as well as bonds, but insisted that I *invest*—that I do not speculate—in stocks. In order to show the investment position of stocks let me first describe the difference between investing and speculating.

"My theory is that either investing or speculating, whether in stocks or bonds, is a matter of method and state of mind, and not a question of choice between the two forms of security.

"I consider that you are speculating when you buy any security, either stock or bond, *if* your prime consideration is the possibility of selling out at an advanced price.

"The speculator does not want to own securities. His mental attitude is not that of a stockholder in a company whose stock he buys. He is just the temporary holder of a piece of paper which he hopes to pass on to someone else at a higher price. To the man who is speculating the list of securities on the stock exchange is just so many names. The only thing that interests him is the plus or minus sign showing whether his security has gone up or down on the day's trading.

"Mine is far from a foolproof definition, but nevertheless I distinguish between speculating and investing in this way: The speculator ignores or subordinates underlying values, stakes all on the chance of a rise in price and is the temporary purchaser for a turn—which he hopes will be a quick turn. The investor demands intrinsic values. Regardless of the possibility of market profit, he is not interested in a security unless it is worth holding as a permanent or a long-time investment.

"The investor, as well as the speculator, hopes his securities will advance in price. Market profit is a perfectly legitimate source of investment income. But the investor puts potential market increase second and intrinsic value first, whereas the speculator puts potential market increase first and intrinsic value second—if he considers the latter at all.

"So long as you trade on margin loss of time from business and a distracted state of mind must be figured into your calculations of stock market gains or losses. On the contrary, the investor, who buys intrinsic values—and knows he owns intrinsic values—is not much concerned over day-to-day price fluctuations."

At this point in Gary Clark's "lecture" Tracy Randall interrupted to ask Gary to explain the relative position of stocks and bonds as investments.

"As owner of stocks," Gary explained, "you are a partner to an enterprise. As the owner of a bond or mortgage you are a preferred creditor. As a stockholder, you own your pro rata share of the assets of a business—all that is left after bonds, mortages and other debts are paid. As a bond holder your claim must be paid before there is anything for the stockholders.

"As a stockholder you share in the net profits of the business. The amount may be large or small, or nothing at all, depending on how the business prospers. As a bond holder you receive a fixed rate of interest on your money, no more, no less.

"Because of their senior position, bonds originally came to be regarded strictly as an investment—stocks as somewhat of a speculation. But this is a changing world. It has been changing rapidly of late years. And economists are changing their views regarding stocks as investments. The rise in cost of living had considerable to do with it.

"In considering the cost of living, we always use the year 1914 as the basis for comparison. According to figures calculated by the National Industrial Conference Board, the value of the dollar declined from 100 cents in 1914 to about 62 cents at the beginning of 1929. These calculations take into consideration the average cost of food, shelter, clothing, fuel and light, and sundries.

"The changing value of the dollar has worked out in this way. An article which you bought in 1914 for $1 now costs you about $1.60. If you had an income of $5,000 in 1914, you would need $8,000 now to maintain the same standard of expenditures. If in 1914 your income was derived from bonds—let us say $100,000 at 5% yielding $5,000—that income today would have no greater purchasing power than $3,000 had in 1914. Therefore, a $100,000 estate invested in bonds in 1914 would have shrunk to $60,000 according to today's standard of dollar purchasing power. Based on 5% securities you would now need $160,000 in bonds to yield an income of $8,000, or the buying power equivalent of your 1914 income of $5,000.

"When you invest in bonds your principal remains at a stationary level and your income is fixed. Neither increases to offset a decline *(Continued on page 5)*

Pinning Tails on Donkeys

(Continued from page 4)

in the purchasing power of the dollar. In the case of stocks, neither principal nor income is fixed. Either or both should grow as time goes on—assuming intelligent original selection of securities.

"As an industry grows and prospers and its earnings increase, it is able to pay larger dividends. That in itself increases the gross yield on a given original investment. And as earnings and dividends advance the value of the stock goes up. Broadly speaking, an investment in good stocks keeps in step with the fluctuating purchasing power of the dollar, whereas an investment of the same amount in bonds does not.

"Quite often, when a company builds up a big surplus out of earnings it capitalizes that surplus by giving new stock to its shareholders—in other words, declares a stock dividend. Suppose a company, capitalized with 100,000 shares, should build up a $10,000,000 surplus. If it desired to convert that surplus into permanent working capital, it might increase its capitalization to 200,000 shares, giving one new share to stockholders for each share already owned. If the rate of dividends remains unchanged after recapitalization, shareholders double their income through owning twice the amount of stock. Looking at it another way, their principal has doubled.

"Should this company have decided not to build up a huge surplus, later to be converted into new stock, it probably would have paid out a greater proportion of its earnings each year through increased dividends. In such a case the investor enjoys a larger income to offset the rising scale of living costs.

"When a company wants to increase its working capital without declaring a stock dividend out of earned surplus, it is customary to grant rights to present stockholders to subscribe to the new stock at a favorable price. Shareholders profit either by purchasing new stock below the market price or by selling their rights to other investors.

"You should not conclude from my remarks that it is arbitrarily good judgment to invest all your money in stocks. Without going into details of all the considerations involved, let me say that usually the soundest investment policy is to invest both in bonds and in stocks, to diversify and gain the benefits of both forms of security.

"Few of us have enough money to diversify our investments very widely. Few of us have the experience and the facilities to make the best selections and to keep close check on a variety of security holdings. But a plan has been devised in recent years which gives every investor, even those of very limited means, the opportunity to share in a large list of carefully selected securities. I refer to the investment trust.

"An investment trust is nothing more or less than a company engaged in the business of making investments. The company sells its own shares (Continued on page 6)

Pinning Tails on Donkeys

(Continued from page 5)

to investors. The money thus obtained is invested in a widely diversified list of securities. From the income of these investments dividends are paid to stockholders in the trust. Therefore one investment trust share represents participation in many securities.

"But whether you invest in shares of an investment trust," concluded Gary Clark, "or whether you purchase stocks or bonds direct, I hope I have made clear the difference between investing and speculating, and have shown you wherein stocks as well as bonds may be purchased for pure investment. I hope I have interested you in *investing.*"

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"How to Build an Independent Income" is the title of a new booklet by the F. H. Smith Company which explains conclusively how people of moderate means may obtain financial prosperity. **"55 Years of Investment Service"** describes the history of progress of the F. H. Smith Company as well as making an attractive suggestion in first mortgage real estate bonds. May be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address Fidelity Bond & Mortgage Co., 1188 New York Life Building, Chicago, Ill.

"The Investment Trust from the Investor's Viewpoint." presents an explanation of this form of investment in easily understood terms, illustrated with some interesting examples of how the general investment trust will help the man with $100 or more to get ahead. Published for free distribution by United States Fiscal Corporation, 50 Broadway, New York. Ask them for Booklet IT.

How to Retire in Fifteen Years is the story of a safe, sure and definite method of establishing an estate and building an independent income which will support you the rest of your life on the basis of your present living budget. Write for the booklet to Cochran & McCluer Company, 46 North Dearborn St., Chicago, Ill.

How to Get the Things You Want tells how you can *use* insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 318 Elm Street, Hartford, Conn., will send you this booklet on request.

The Guaranteed Way to Financial Independence tells how a definite monthly savings plan will bring you financial independence. Write for this booklet to Investors Syndicate, 100 North Seventh Street, Minneapolis, Minn.

The Making of a Good Investment tells how 6½% can be made on investment in First Mortgage Bonds in units of $50, $100, $250, $500 and $1000; how the bonds are protected and how simple it is to purchase them. For a copy of this booklet address United States Mortgage Bond Company, Limited, Detroit, Michigan.

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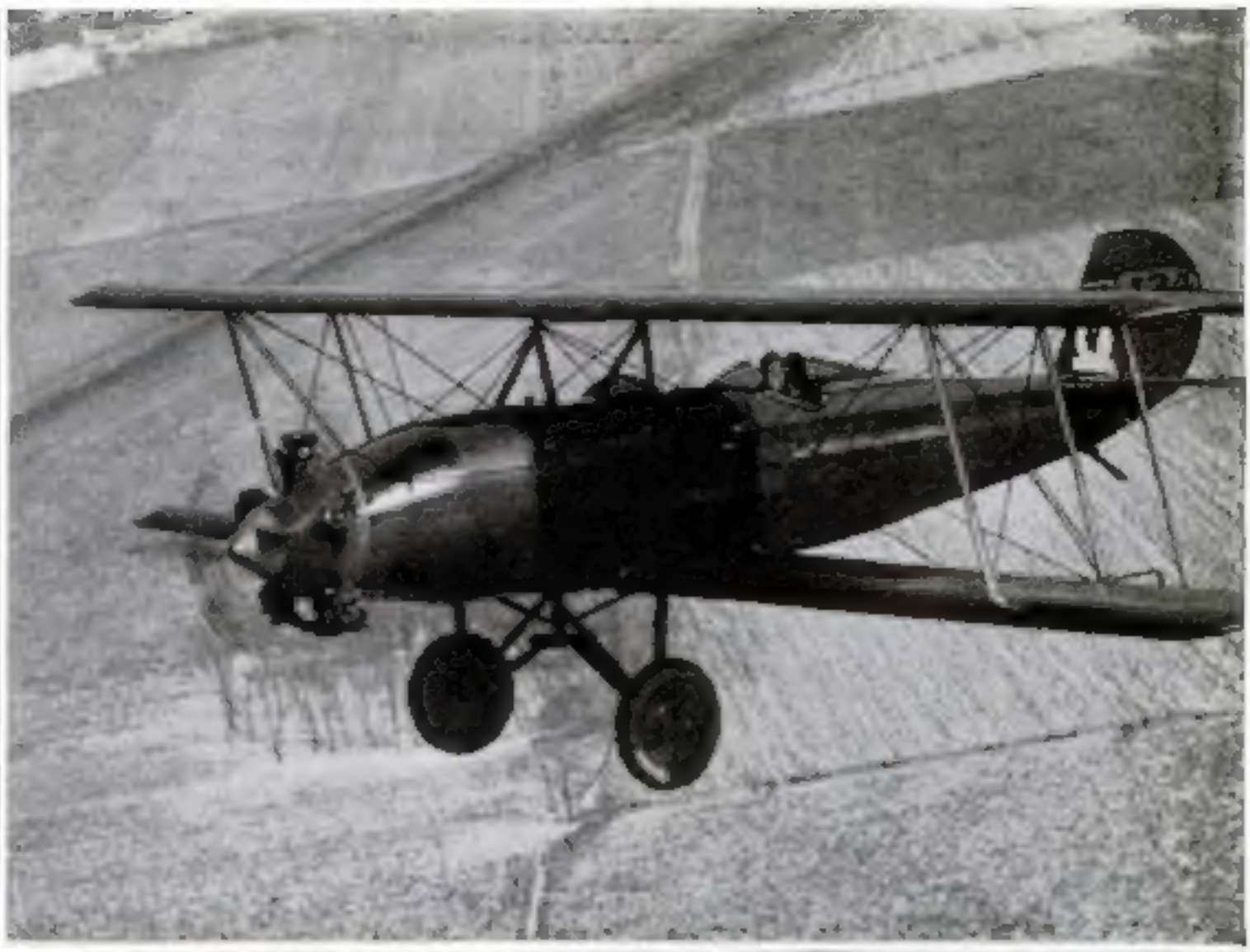


The Kinner Powered American Eagle Biplane is manufactured under Approved Type Certificate No. 124, and is priced $4,595, flyaway Kansas City. American Eagle airplanes are also powered with Hispano Suiza, Wright Whirlwind, OX5 and OXX6 Curtiss, Axelson and LeBlond motors. There's an American Eagle for every purse and purpose!

AMERICAN EAGLE does it again!

The world of aviation naturally looks to American Eagle for the outstanding new airplane of the year. Yet even so, the new Kinner Powered American Eagle Biplane comes as a startling achievement. No one can believe its uncanny performance without actually seeing it. Here—at last—is a plane which all but *flies itself!*

Dive it to terminal speed with any load—release the controls—and after two or three oscillations it will level off perfectly! . . . Pull it into a stall—release the controls—and it will level off with no help from the pilot! . . . Force it into a spin—let it spin as far as you like regardless of load—and it rights itself with no hand on the controls and continues in level flight!

We are eager to demonstrate. *See the American Eagle dealer nearest you or write for complete information and interesting literature.* An extraordinary sales proposition is now being offered to dealers and distributors.

Here's a typical report giving actual facts on the performance of the Kinner Powered American Eagle Biplane: "Arrived Montgomery from Kansas City with no adjustment of any nature in motor or ship. Following figures based on 1,032 miles: Cruising flight 15 hours average 8.8 miles per gallon, 7.8 gallons per hour. 125 miles per quart of oil. 70 miles per hour against head wind to Birmingham. Cost of gas and oil 2.5c per mile."

***(Signed)* L. G. MASON,**
President Montgomery School of Aeronautics, Montgomery, Alabama

AMERICAN EAGLE AIRCRAFT CORP. AMERICAN EAGLE & FAIRFAX ROADS KANSAS CITY, KANSAS

The Institute—Yours to Use

The Sage Research Laboratory, New York University, where $500,000 worth of testing equipment is available for use

Its Investigations, Tests, and Reliable Service Are Free to Readers on Request

By F. G. Pryor

Secretary, Popular Science Institute

IF YOU are like most people, you often gamble when you buy. But "taking a chance" is something that the U. S. Government and great industrial organizations never do; they go to all kinds of expense to investigate equipment rather than risk a dollar in something that may be inferior.

These organizations first determine just what is required of a material to give them satisfaction. Then they find out what particular makes are up to such requirements. It costs big industry a lot to find out this through expensive tests and research, but they consider the information cheap at any price. They are right, too, for the small buyer who has to buy on the "take a chance" principle, learning by experience, pays more heavily for his knowledge than do the great organizations that get their information through costly research.

Help for the Buyer

IT WAS to provide the small buyer with the advantages of costly research that Popular Science Institute was established. By investigating products of semiscientific nature that a man purchases once, twice, or maybe three times in a lifetime—products that he would learn about slowly and expensively through experience—the Institute aims to give a service valuable to readers of POPULAR SCIENCE MONTHLY. Judging from the hundreds of readers who keep coming back to Popular Science Institute for advice every time they buy equipment within the classifications of products covered by its investigations, they do find this service valuable. Here, for example, is a letter from a Detroit reader:

"I want a good refrigerator. Will you please give me the names of those that will give good service and satisfaction?

"The oil burner (recommended by Popular Science Institute) that I put in one year ago last month has given the best of service and no trouble at all. Many thanks for past and future service."

The investment in oil heating equipment made by the writer of this letter amounted to several hundred dollars. This is a large amount to gamble with, but it would not have warranted his spending several thousand dollars—as Popular Science Institute did—to investigate different oil burners in order to find out which makes were worth buying. By taking advantage of the coöperative research findings of Popular Science Institute, he was protected in making his purchase.

Making the Right Choice

NOW, this reader plans to buy a refrigerator. There is little outside evidence to give the refrigerator buyer a clue whether he is choosing correctly or whether he is getting a refrigerator that is poorly insulated, expensive to operate, and incapable of maintaining proper temperatures. One refrigerator looks very like another these days, and it is up to the buyer to guess about the merits of construction. Sometimes the price offers a guide, yet Popular Science Institute has found some high priced refrigerators to be poor value. Again the reputation of the manufacturer proves helpful to a certain extent, but most manufacturers are obliged to put out different lines to comply with price demand on the part of the consumer. Advice of friends, too, provides the buyer with some basis for choosing, but such advice in most instances is the result of rather limited experience.

It is desirable for the individual buyer, like great organizations, to have a more accurate guide to the merits of equipment in which he is investing than the rather haphazard and chance methods mentioned above. The findings of Popular Science Institute, through its extensive laboratory tests and investigations, provide buyers with a real and absolute guide. In selecting products approved by the Institute, readers know that all the technical features of design, construction, and quality have been carefully judged for them by engineering experts.

What the Institute Offers

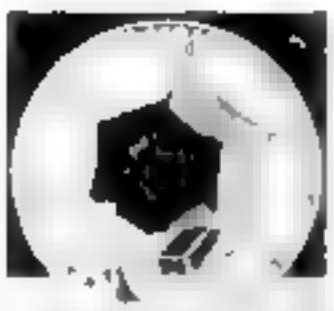
THE information supplied by the Institute may be relied upon absolutely because of the thorough and impartial way in which it is gathered. The tests are made by a staff of experts at the Sage Research Laboratory at New York University, where $500,000 worth of testing equipment is available for use. All decisions as to which products deserve approval are made by Professor Collins P. Bliss, Director of Popular Science Institute and Associate Dean of the College of Engineering, New York University. Also, Dean Bliss has recently been appointed to the staff of the U. S. Bureau of Standards as consulting mechanical engineer.

The products investigated by Popular Science Institute come under the four classifications of radio, tool, refrigeration, and oil heating equipment. The Institute is also prepared to supply the advice of building experts in connection with building materials and problems encountered in house construction.

Readers of POPULAR SCIENCE MONTHLY are invited to take full advantage of the free service offered them through the Institute. Inquiries and requests for lists of approved equipment will be gladly taken care of and they should be addressed to Popular Science Institute, 250 Fourth Ave., New York, N. Y.

How this *grainless* wood started a box maker in the toy business

Here are the facts about a box maker who improved one product, developed another and cut material waste to 2% by adopting Masonite Presdwood. In scores of other industries this grainless wood has proved equally profitable. Perhaps you, too, can employ it to advantage. Samples for test gladly supplied.



THE LEWIS TEST DRUM

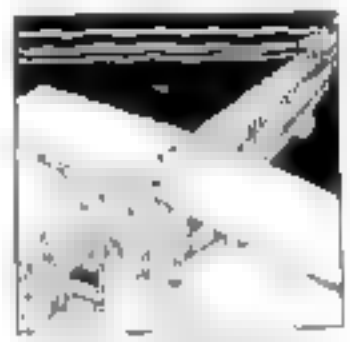
Striking sharp steel projections in the revolving test drum, dropped 4,193 times before it broke, a Masonite Presdwood box, with light sheet metal covering, proved itself vastly superior to a similar box of all-steel construction. The test resulted in the adoption of this grainless wood by the G. B. Lewis Company of Watertown, Wisconsin, for use in its Multitrip Boxes. Then it was found that the scraps from the box factory were ideal for toys.

No cross grain in Presdwood

These smaller pieces of Masonite Presdwood were really scraps in size alone. Toys of this grainless material are ideal for small children because of freedom from splinters. Resistance to warping insured durability for toys that might be left out of doors. The naturally attractive appearance of Presdwood was recognized as a sales asset not to be passed by lightly.

Thus is explained the appearance of Arkitoy construction sets in the toy shops and department stores last Christmas.

But Presdwood does much more than build strong boxes and light toys. It panels ceilings of railroad coaches and the salons of steamers. It serves in hulls and decks of fast hydroplanes and makes sturdy side panels for motor trucks.



FOR MAKING ARKITOYS

Where outdoor signs are made in quantities you will find it ordered by the carload because of its ability to stand the weather and take any paint finish.

It panels walls and ceilings of fine homes and adds an air of distinction to corridors and offices of stately buildings. It builds strong partitions and light shelving; lines closets and elevator shafts. Where builders want a specially fine surface on the outside of a building they use Presdwood to line the concrete forms.

Production managers like to use it in the factory. Home mechanics find it handy to have for odd jobs around the house.

Never harms fine tools

This easily worked material never harms good tools for it is made entirely of wood—contains no artificial binder. It comes in 4-foot by 12-foot boards, either $\frac{1}{8}$ inch or $\frac{7}{16}$ inch thick. It can be punched, die-cut, milled or sawed.

Builders, factory executives and home owners should send for the booklet which tells the fascinating story of Presdwood and beautifully illustrates many of its uses.

MASONITE CORPORATION
Dept. 727, 111 West Washington Street
Chicago, Illinois

FOR STEAMBOAT PANELING

Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR CEILINGS OF RAILWAY COACHES

Our Readers Say—

Moral: "Fix It Yourself"

"WE BOAST of our mechanical age, tell how we have been relieved of labor by our washing machines, electric toasters, etc.; how radio, the automobile, and so on have brought the world to our doors.

"All very pretty, say I, but there's another side to the picture. The vast new use of electrical and mechanical devices of various kinds has just made most of us the prey of a new race of gyps. Unless you're a graduate engineer, an electrician, and a journeyman machinist, you're a shining mark for these bandits the first time your radio set, automobile, or whatever else happens to go wrong.

"I once paid $2.45 for the time it took a so-called automobile mechanic to make a tencent gasket that he just didn't happen to have in stock and wouldn't bother to get from another garage on the same block. A neighbor tells me that the local Marconi tried to collect $6 plus the price of a tube from him for repairing his set. All the poor set required was a new tube, and changing the tube was all the work that was done on it.

"How many householders have had to pay $3 or $4 to some alleged electrical expert for putting twenty cents' worth of resistance wire in a flatiron that wouldn't 'het'? Wish you'd send me the address of Gus and Joe. 'Twould be a pleasure and relief to meet a couple of mechanics who have their minds on their job, not on robbing the public."—J. R. L., Trenton, N. J.

Does He Hold the Record?

"I STARTED to read POPULAR SCIENCE MONTHLY in May of 1881 and I cannot recall that I have missed a single issue since. Through all these years it has kept me up to the things that were going on. I claim the championship as the oldest reader of POPULAR SCIENCE MONTHLY.—A. R. McC., Philadelphia, Pa.

Turn to Page 61

"IN A recent issue you had two interesting pieces about frogs. One told how they can learn a simple lesson in geometry. The other described how an army of bullfrogs is going to fight mosquitoes in Alaska. Pretty soon you'll have Owen Wister's Virginian backed off the map in the way of frog stories. I wouldn't be surprised any month now to see an article in POPULAR SCIENCE explaining how a big bass bullfrog was taught to sing 'Rocked in the Cradle of the Deep.'"—R. B. N., St. Paul, Minn.

Test Your Memory

"I NOTICE the numerous allusions to Lindbergh and his trans-Atlantic flight. It seems to me that America is paying a poor compliment to herself in being so enthusiastic over an extremely courageous action, but one which was first achieved by Englishmen over eight years before, at a time when airplanes were much more unreliable. And though the names of Alcock and Brown must be known to every American, I wonder how many know the names of the crew of the British airship who were the first to cross the Atlantic from east to west?"—R. P. H., Barnsley, Yorkshire, England.

Why Get Excited?

"IN THE upper left-hand corner of 'Our Readers Say' page last month was a letter from O. T. K. putting a wet blanket on Larry Brent and his stories 'I Am Learning to Be a Flyer.' After reading this O. T. K. and previous letters which have been given the place of honor in that same position on the page, I suggest that in future issues of POPULAR SCIENCE you call it 'The Nuts' Corner.'"—A. M. L., Atlanta, Ga.

Stuck in the Cobwebs

"IN YOUR editorial, 'Protecting Yankee Ingenuity,' readers are urged to tell of delays they experienced with the U. S. Patent Office, so I would like to add my grievance to that of others.

"On February 7, 1928, I had an application for patent filed at the Patent Office and have recently been informed that it will probably be eight months yet before the case is again considered by the examiner. If a patent is allowed and issued I will have paid to the Patent Office $40, and it seems to me that for that amount I am entitled to much quicker service.

"I have a letter on the subject from one of our Senators whom I wrote to about it and who intimated that someone should be put in authority who will know how to bring the business out of the rut in which it has been running for so long a time.

"I am working on several inventions which I hope to have patented, but the delay that I have already experienced is discouraging."—A. W. B., Spokane, Wash.

Before Prohibition

"I MUST dispute the statement in your magazine by Karl P. Schmidt, assistant curator in the Field Museum, Chicago, that the belief in 'glass snakes' is an error. A number of years ago I found several of these 'glass snakes' in central Indiana. They were about three eighths of an inch in diameter and from twelve to fifteen inches in length, with light cream and cream colored stripes, similar to garter snakes, but less distinct. When struck with a stick they would snap into three or four pieces. The broken pieces would jump and squirm about, but I never observed them long enough to see what ultimately became of them. The ends of the broken pieces were always square, as if cut by a sharp knife, and a white gummy substance would exude therefrom.

"In later years I was told that, if the broken pieces were left alone, they would squirm about until the several ends again became joined and whole. For this I cannot vouch, but on striking the last one of these snakes I found with a light stick it snapped into pieces, as usual. I left them in the path, but on returning half an hour later the snake had disappeared."—A. C. G., Waterloo, Ind.

Fit Like a Glove!

"A RECENT item in your magazine stated that 'science needs another word to designate what we now call ultra-violet light.' I suggest this name: 'Invita rays. It is a combination of the words invisible and vital.—J. M. R., Southington, Conn.

I suggest 'Zoon ray' or 'Bion ray.' Both of these names designate the life-giving quality of the ultra-violet ray.—Mrs. W. W. C., Bowling Green, O.

I offer the following definitions in reference to the actinic power of the rays, or their power to darken silver chloride. 'Nox' is Latin for night, and refers to their invisibility.—R. C. J., Jefferson, N. Y.

It is easy enough to find a name for ultra-violet rays. 'Hyperion' means just that—hyper, beyond, and 'ion'—violet, in Greek.—H. W. M., Belmont, Mass.

Oh, for a Solomon!

"WHAT'S the sense of publishing all the articles on how to build things? Nowadays, when good radio sets, furniture, and such can be purchased so reasonably, most people don't have the time nor inclination to make these things themselves. Personally I'd like to see more articles on chemistry, astronomy, invention, and general science. Your workshop section is so much waste paper as far as I'm concerned."—D. J. O'D., Wilmington, Del.

"You can tear out the whole first half of POPULAR SCIENCE and keep it. Only leave me the Home Workshop and the Better Shop Methods sections.—A. N. S., Seattle, Wash.

What About It, Captain?

"I SHOULD like to offer my humble appreciation of Captain McCann's ship models, which are the best in a long time for a novice such as myself. I understand that you are open to suggestions. May I offer one? I should like to see Captain McCann design a model of a modern steamer of some sort, either a passenger ship or freighter. Captain McCann has been so successful with the old-time sail ships that he could get up a steamer that we amateurs could build without any of the customary complicated rigging so apparent in the ordinary model.—E. H. J., Victoria, Tex.

"I recently constructed a model of the *Santa Maria* from your blueprints and donated it to the Parent-Teachers' Association for the benefit of the needy children's school fund and they derived $650 from the sale of this model."—F. H. M., Dade City, Fla.

You wouldn't care to meet Marvin

Money. Charm. Ability. In all New York there was no abler man in his field. Yet people called him "the prince of pariahs."

Men thought him a great fellow for a little while. Women grew romantic about him—until they knew. People welcomed him at first—then dropped him as though he were an outcast.

Poor Marvin, yearning so for companionship and always denied it. Poor Marvin, ignorant of his nickname and ignorant, likewise, of the foundation for it.

Halitosis (unpleasant breath) is the damning, unforgivable, social fault. It doesn't announce its presence to its victims. Consequently it is the last thing people suspect themselves of having—*but it ought to be the first.*

For halitosis is a definite daily threat to all. And for very obvious reasons, physicians explain. So slight a matter as a decaying tooth may cause it. Or an abnormal condition of the gums. Or fermenting food particles skipped by the tooth brush. Or minor nose and throat infections. Or excesses of eating, drinking and smoking.

Intelligent people recognize the risk and minimize it by the regular use of full strength Listerine as a mouth wash and gargle. Night and morning. And between times before meeting others.

Listerine quickly checks halitosis because Listerine is an effective antiseptic and germicide* which immediately strikes at the cause of odors. Furthermore, it is a powerful deodorant, capable of overcoming even the scent of onion and fish.

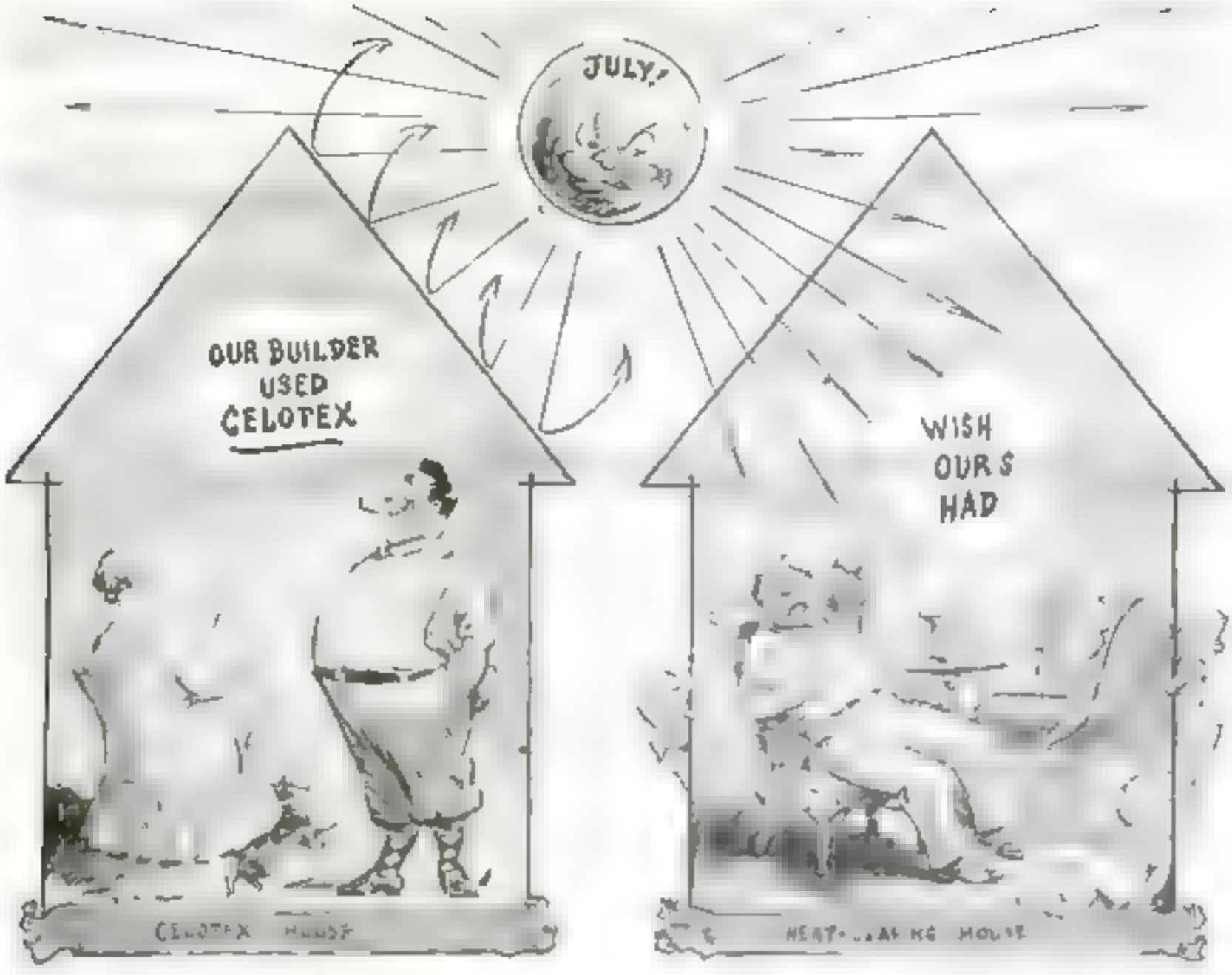
Keep Listerine handy in home and office. Carry it when you travel. Take it with you on your vacation. It is better to be safe than snubbed. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

* * *

***Full strength Listerine is so safe it may be used in any body cavity, yet so powerful it kills even the stubborn Bacillus Typhosus (typhoid) and Staphylococcus Aureus (pus) germs in 15 seconds. We could not make this statement unless we were prepared to prove it to the entire satisfaction of the medical profession and the U. S. Government.**

Winning new users by thousands. Listerine Tooth Paste. The large tube 25¢

LISTERINE



Cool, Pleasant Rooms

even when it's 90° outside!

NO MORE suffering from summer heat for the families of *wise* homeowners. For nowadays they live in houses insulated with Celotex—houses that are cool and pleasant even when it's 90° outside.

Celotex *shuts out* scorching sun's rays during summer months. Through other seasons it protects you from chill, dampness and cold . . . keeps your home at a healthful, comfortable temperature *all year 'round.*

As a heat stopper, an inch of Celotex is as effective as 3 inches of wood, 8 inches of plasterboard, 12 inches of brick and 25 inches of concrete.

Celotex is the *only* insulation made from long, tough fibres of cane. It comes in big, strong boards, 4 feet wide, 7 to 12 feet long and 7/16 of an inch thick. Also made double-thick—7/8 inch.

When used on the outside of houses, as sheathing, Celotex adds structural strength . . . makes walls tighter and more permanent.

And on inside walls and ceilings, you can obtain finer, smoother plastered surfaces with Celotex Lath. This new lath, 18 inches by 48 inches and 7/16 of an inch thick (also made double-thick—7/8 inch), is especially designed to reinforce against plaster cracks and to eliminate disfiguring lath marks.

Celotex is used in old homes as well as new; for insulating roofs; for lining basements, attics and garages; for making comfortable extra rooms from waste spaces.

Ask your architect, builder or dealer for further information on Celotex—and write to us for our free booklet, "Year 'Round Comfort and Fuel Saving for Every Home."

The Celotex Company, Chicago, Illinois. In Canada: Alexander Murray & Co., Ltd., Montreal. Sales distributors throughout the world. All reliable dealers can supply Celotex Standard Building Board and Celotex Lath.

Be sure it's *Cane Fibre* Insulation!

Only Celotex is made from the long, tough fibres of cane. The peculiar advantages of cane fibre insulation cannot be obtained in any other material. Be sure you get CELOTEX!

The word CELOTEX [illegible]

CELOTEX

BRAND

INSULATING CANE BOARD

When you buy a new house, look for the Celotex sign. It is your assurance of greater home comfort.

Popular Science
MONTHLY

JULY, 1929 SUMNER BLOSSOM *Editor* VOL. 115, NO. 1

IF YOUR doctor should give you only one year to live, what would you do? That's the situation these five girls faced a year ago. Twelve months have passed and they're still smiling. This intensely human article tells why. Left to right are: Mrs. Quinta McDonald, Mrs. Edna Hampton, Mrs. Albina Larice, Miss Katherine Schaub, Miss Grace Fryer

Doomed to Die—and They Live!

Medical Science Brings a Ray of Hope Into the Tragic Lives of Five Girls Poisoned by Radium

By ROBERT E. MARTIN

A FEW weeks ago, two of the five New Jersey girls who are believed to be slowly dying from radium poisoning they contracted while painting luminous watch dials were taken to the Memorial Hospital in New York City and subjected to an entirely new course of treatment. An almost impenetrable cloak of mystery was thrown over the proceedings. Hospital officials refused all information, and the doctors in charge declined to reveal the nature of the attempted cure and of the effects they expected from it.

But through this screen of professional secrecy, one fact stood out with the cheery brightness of a beacon amid utter darkness. That was that the board of distinguished physicians who, for about a year, have been studying the cases of the five women, have not relinquished all hope of remedying their strange and terrible disease.

Slight as this hope may be, it gains some strength if considered with other developments in the stirring tragedy. It is now just a year since each of the young women received a $10,000 compensation in cash and a pension of $600 annually for "life" from the radium company which had employed them. At that time, the medical profession predicted that they had but one year to live. The twelve months have passed. All of the five girls are alive and doctors declare their condition is only "a little worse" than in June, 1928.

When medical science passed sentence on the patients, their lingering ailment was diagnosed as "radium necrosis." Necrosis means mortification or death. In other words, it was supposed that the bones and blood-making centers of the young women were dying as a result of the activity of the radium their systems had absorbed. In the face of this master and unknown disease, medicine was virtually impotent.

But now it appears that science has made a second guess. The cause of the girls dreadful suffering may after all not be radium but mesothorium, another radioactive substance. Radium is insoluble and loses half of its potency in 1,750 years! Mesothorium, however, is not only soluble, so that it can be gradually eliminated from the human body, but half of its strength is dissipated in six and seven tenths years. Thus, if the mesothorium theory proves correct, the doomed women, whose first symptoms appeared about 1925, will be "reprieved" in a couple of years and, though broken in health or crippled, may live to a ripe old age!

THIS amazing human drama, which may end tragically or comparatively happily, opened about twelve years ago. It was war time. The five young women, now either in their late twenties or early thirties, then between fifteen and twenty years old, were part of a group of some hundred light-hearted girls employed by the United States Radium Corporation at

As Mrs Hussman caught sight of herself in the mirror she screamed and fell in a dead faint In the dark room, the mirror reflected a ghastly light radiating from her body and her face and hair were weirdly luminous

its paint in Orange, N J. They did piecework on watch dials, painting over the numerals with the radioactive stuff that enables you and me to tell time in the dark. The girls liked their work. Not only was it well paid, but there was an added incentive in the idea that many of the watches were to be used by American doughboys in the darkness of the trenches in France Either to speed up their output or to save as much of the expensive paint as possible the young workers would "point their camel's-hair brushes with their lips. That s how the destructive element whatever its name entered their systems.

ALL went well for several years. But suddenly from a clear sky there came an ominous though unheeded warning. In the beginning of 1925, news reached this country that a French chemist by the name of Dementroux, who had been a laboratory assistant of Professor and Madame Curie, the discoverers of radium, had died in agony after a lingering illness caused by constant exposure to radioactive substances. So far as is known, this was the first intimation that the highly-prized beneficent element, isolated by Madame Curie in 1911, and hailed by science as one of the greatest boons ever bestowed upon mankind could turn into a Frankenstein monster

Then dire things began to happen on this side of the Atlantic. In March of the same year, Mrs. Margaret Carlough of East Orange, N. J., broken in health, sued the radium corporation for $75,000. The suit attracted little attention, but its significance dawned on the public when the following June Dr. Edward H Leh man chief chemist of the corporation and one of the country s leading authorities on radium, died of "pernicious anemia."

A FEW days afterward, the late Dr S. A. von Sochocky, eminent radium expert and one-time vice president of the corporation, who devised the luminous paint formula and who died last November, himself a victim of contact with radioactive substances, issued a statement suggesting that all persons who had worked with such materials at once undergo a thorough physical examination

Apparently his advice was taken for, during the remainder of 1925, several damage suits were brought against the corporation by women who had been in its employ and were suffering from mysterious maladies. Medical science was baffled by these diseases, which were variously diagnosed as anemia, dental trouble, angina, and rheumatism. Some of these women died while their suits were pending, but the real cause of their deaths did not become known until three years later

EARLY last year, a new and glaring light was thrown upon the entire situation. At that time, the five young New Jersey women simultaneously started suit for $250,000 each. The plaintiffs were Miss Grace Fryer, of Orange; Mrs. Edna Hussman, of Hillside, Miss Katherine Schaub, of Newark; and Mrs. Albina Larice and Mrs. Quinta McDonald, sisters, of Orange. They were exceedingly ill and had been told by physicians that their chances of recovery were slight.

Nation-wide public interest and sympathy were aroused, and the medical profession became deeply concerned with the cases when Mrs. Hussman's experiences were learned. This happily married young woman, the wife of a plumber, had been very ill, but had been told by physicians that, with medical care and a change of diet, she might improve But one night, as she arose to take her medicine, she caught sight of herself in a mirror. With a heart-rending scream, she fell in a dead faint When she came to, she told her husband that in the dark room, the mirror had reflected a shimmery, ghostly light that radiated from her body! The image of her face and hair, too, had been weirdly luminous.

THAT started medical investigation in earnest. Dr. H. S. Martland, chief medical examiner of Essex County N J., ordered some of the bodies of former women radium workers who had died to be exhumed. One of these bodies, buried three years previously, was that of a sister of Mrs. Larice and Mrs. McDonald. Bones of the foot were placed on a photographic plate in a dark room and left for several days. At the end of that period, the bones had literally photographed themselves!

Here, at last, was the key to the medical mystery! All of the bones were then subjected to examination and it was found that the entire skeleton contained a total of ten micrograms of a radioactive substance. The smallness of this quantity may be estimated from the fact that it takes 1,000,000 micrograms to make one gram and 454 grams to make one pound! Yet, the minute part of the radioactive deposit contained in the bones of one foot alone had emitted rays of sufficient strength to register on the sensitive photographic emulsion!

While the damage suits were in progress, exhaustive study was made of the condition of the five young women. It was then that the physicians concluded that they were slowly dying from "radium necrosis." And "one more year to live" was the verdict.

IN THE light of these findings, it appeared probable that any settlement the plaintiffs could obtain might be a post mortem one. Acting outside his judicial capacity, Judge William Clark, of Newark, a Federal District Judge, volunteered as mediator between the attorneys for the radium corporation and those for the five women. At his instigation, a unique out-of-court settlement was effected. Last June, each of the women received a $10,000 check and the assurance of a pension of $600 a year as long as she might live. Their lawyers' fees were paid and provision was made both for past and future medical care. A medical board to take charge of their cases was appointed. It consists of Dr. James Ewing, professor of pathology in Cornell Medical College and director of cancer research and pathology at the Memorial Hospital, New York; Dr. Lloyd F. Craver, assistant director of cancer research and examining physician at Memorial Hospital, and Dr. E. H. Grunmaar, professor of pathology in the University of Pennsylvania, at Philadelphia.

It was Dr. Ewing, assisted by Dr. Craver, who recently subjected two of the five patients to the new mysterious treatment. These two, believed to be the least affected by the disease among the five, were Miss Fryer and Mrs. Hussman.

Will the five young women live or die? Dr. Ewing and Dr. Craver keep their own counsel, though their actions plainly indicate that they are not without hope. However, Dr. Robert E. Humphries, of the Orthopedic Hospital, Newark, who has treated them continuously since their symptoms first appeared in 1925, frankly expresses hope that their meager expectancy of life may be indefinitely prolonged. This hope he bases on science's second guess—the mesothorium theory—and he feels that means may be found of dissolving and eliminating the substance and of rebuilding the wasted bone and blood tissues. Dr. Martland, too, believes that the patients have a fighting chance—if the poison in their systems is mesothorium.

THE question of life and death for the five unfortunate girls, then, may be briefly stated in three words.

Radium or mesothorium?

Radium, a product of disintegration in a series of elements that commences with uranium and ends, after millions of years, with lead, emits so-called alpha, beta, and gamma rays. The alpha rays consist of positively charged nuclei of helium atoms. Their velocity may attain one tenth of the speed of light, or 18,600 miles per second! The beta rays are streams of negatively charged electrons, similar to the cathode rays of high velocity produced in the laboratory with certain vacuum tubes.

The late Dr. S. A. von Sochocky, who devised luminous paint formula, and died from effects of radioactivity. In the bowl is radium salt worth $120,000.

Their speed ranges from one tenth the velocity of light to one that almost equals it—180,000 miles per second! The gamma rays are radiations of very short wave length, but they are 100 times more penetrating than beta rays.

Now, ninety-nine percent of the rays emitted by radium are alpha rays, so, if radium is at the bottom of the women's trouble, this kind of rays apparently does the damage. The alpha rays have very little penetrative power—approximately one twenty sixth of an inch—but when radium is deposited in the bones, the distance to the blood producing centers located in the bones is sufficiently short for the rays to reach them. The deposits at first produce a stimulation to these blood-forming centers and the person affected feels better than normally. The white and red blood corpuscles even increase in number. But in time, this stimulative period is followed by a destructive effect on the blood producing centers so that they fail to manufacture the vital cells. The white corpuscles are reduced in number and the red are not properly formed. A condition of anemia develops, the gravity of which depends on the size of the deposit and the susceptibility of the patient.

Miss Katherine Schaub, youngest of the five victims enjoying vacation in the Catskills. She is pursuing a literary career.

DAY after day, week after week, month after month, and year after year, the constant bombardment of the alpha rays goes on, especially in those parts of the skeleton subject to pressure or weight. The final result is necrosis.

Radium, as has been said, loses half of its strength in 1,750 years. At present, there is nothing known to science that will cause it to become soluble so that the body may get rid of it. The deposits can be removed only by cremating the bone and then boiling the ashes in hydrochloric acid!

Mesothorium, another radioactive substance, is a transmutation product of thorium. It emits only the terrifically speedy beta rays. Hence, it is even more irritating than radium, but on the other hand, half of its potency is spent after 6.7 years, and—it is soluble. That is why the women have a fighting chance if it was mesothorium and not radium they swallowed when they pointed the little brushes with their lips.

The paint contained crystalline zinc sulphide to which either radium or mesothorium salts were added and "a little gum arabic to make it stick to the watch dials.

But why, you may ask, is it not definitely known whether radium or mesothorium was used to make the stuff luminous? The answer is simple. It was a trade secret and, apparently, Dr. von Sochocky, the inventor, took it with him to the grave.

How exhumed foot bones of a radium victim, left in a dark room, photographed themselves!

DURING the last few years of his life, the Austrian physician and chemist himself was a prey to intense suffering. His teeth dropped out and the tips of his fingers turned black. He prolonged his life by taking frequent vacations in high altitudes, a well-known cure for anemia. In such regions, less oxygen is taken into the body, and since the system needs the usual quantity for the tissues, Nature compensates by causing an increase in the red cells which carry oxygen to the lungs through the blood.

Aside from Dr. von Sochocky and Dr. Lehman, fifteen radium workers, all women, have died in New Jersey since 1923 and at least fifty more have suffered severe illness. Aroused by this heavy toll, physicians, labor (Continued on page 136)

TALKING TO THE SOUTH POLE

The 10,000 mile radio bridge between New York and Little America. Inset shows Commander Byrd at microphone in camp and newspaper office where Antarctic messages are received

STANDING on the edge of the great Ross Sea Barrier, [illegible] members of the Byrd Expedition watched the sun sink below the horizon for the long Antarctic night. A few hours later, a description of that scene was available to newspaper readers all over America. The adventures of this hardy band of explorers are front page news in half a hundred papers. How that news leaps a 10,000-mile gap with the speed of light is a triumph of short-wave radio transmission.

Since the expedition left New York last September, it has not missed a night's communication. More than 150,000 words in press dispatches have traveled over the invisible bridge from the lonely Antarctic to New York. One night 8,500 words were sent and received.

At ten o'clock each night a radio operator in the editorial rooms in the New York Times Annex receives the day's dispatch from the reporter with the Byrd party. Simultaneously, this message is picked up by a short wave radio station at Woodside, Long Island, a few miles away. If, as occasionally happens, electrical interference in the city prevents clear reception in the Times Annex building, the signals are relayed over telephone wires from the Long Island station to the newspaper radio room.

In an hour or so the whole story is on the presses in New York and is going by cable, telegraph, and wireless to newspapers in every part of the world.

From the New York station personal messages are sent to Commander Byrd and his men and at one o'clock each morning there is radioed to them a summary of news to be published in the papers then on the presses.

The success of radio to the South Polar regions has exceeded all expectations. If members of the Byrd Expedition fly over the South Pole, the story of their success may reach America long before the plane returns from the flight! Already radio messages have been exchanged between the Times station and a plane 3,000 feet above Little America—a long distance record for radio from plane to ground

What John D. Rockefeller Has Done for Me

By HENRY MORTON ROBINSON

DID you ever think of John D. Rockefeller as a tremendous, vital power in the advance of science? Neither did I until Mr. Robinson, returning from an interview with him, showed me this absorbing article. I'm sure it will open your eyes, as it did mine.—The Editor.

WHAT image flashes into your mind when you hear the name of John D. Rockefeller? Do you get the familiar picture of a wrinkled, dyspeptic old man, wielding a feeble golf club and gingerly slipping thin dimes to caddies, porters and the neighbors' children?

If you were born after the turn of the century, the chances to one that's about the reaction you have to John D.'s name. But if you were using Mr. Rockefeller's kerosene in your parlor lamps prior to 1900, you probably get another picture and a much darker one. The Rockefeller of those days was represented as a many-tentacled octopus, the mightiest of money magnates, and the poor man's enemy. By raising the price of oil a cent a gallon, he was reputed to double his wealth every week. And it was generally believed that he would have exchanged all his wealth for the pleasure of eating a single hearty meal.

BUT behind these two more or less familiar caricatures of John Davidson Rockefeller, there is another picture of Rockefeller the humanitarian, the staunch friend of the sick and the needy, the promoter of medical research, and the greatest benefactor of science who ever lived. This Rockefeller, now approaching the age of ninety, neither totters around a golf course, nor slips worn dimes to his cronies. In the past twenty years this Rockefeller has given *five hundred and fifty million dollars* outright to scientific research and the promotion of public health. Through the agency of the Rockefeller Foundation he has given away five times more money than any philanthropist in the history of the world, and has given it five times more intelligently. For although there are no strings attached to his donations, John D. doesn't waste his ammunition. He insists that every dollar of it must be a golden bullet in the war of Science vs. Sickness, Suffering and Death.

But how does all this generosity affect *me?*" was my very natural question on learning of the huge sums disbursed by the Oil King. "Five hundred and fifty millions is a mountain of money, but how am I personally benefited by it? Am I healthier, wealthier, and wiser as the result of these staggering donations? Will my family and I live longer, suffer less from disease, and enjoy life more because of John D.'s gifts?"

The answer to these questions—no matter where I live or what my occupation may be—is a unanimous *Yes.* If I am rich or poor, black, white or yellow, employer or employed, I find, after investigating the matter, that I can claim a positive share of the scientific benefits that John D. Rockefeller has heaped upon mankind.

IF, FOR example, I am stricken with pneumonia—formerly regarded by medical men as the most treacherous of all [illegible]—I know that my chances of recovery are 74.6 percent higher than they were four years ago, thanks to the Type I pneumonia serum discovered by doctors at the Rockefeller Institute for Medical Research, in New York City. In the enormous laboratory, the largest of its kind in the world, a dozen scientists are at this moment perfecting serums for the treatment of Type II and Type III pneumonias. If these serums prove as effective as the Type I variety, the mortality from pneumonia will take a still greater drop. It took exactly $189,000, out of Mr. Rockefeller's money (a fair-sized Liberty Loan) to endow the Institute for Medical Research. But he recently stated that the discovery of the Type I serum alone has completely justified that outlay. And after observing the curative effect of the serum upon my infant nephew, I heartily agree with him.

Speaking of infants, the little ones have always been Mr. Rockefeller's special province of interest. Some years ago, while the-

Herbert Johnson in the Philadelphia North American

Cartoons of the early 1900's picturing John D. as money ogre and enemy of common people.

Special guest of the Children's Health Station at the Rockefeller exhibit is this two year old at the entrance to Memorial Court at Tarrytown, N. Y. Clutched in the baby's left hand, of course, is a new dime

Turning the tables on John D.—Will Rogers (left) a guest of Rockefeller at Ormond Beach, Fla., hands him a dime, saying "Don't spend that too fast"

cussing a public health program with George L. Vincent, Executive Chairman of the Rockefeller Foundation. Mr. Rockefeller remarked thoughtfully:

"GEORGE, why don't we do something for the babies—especially the babies of the poor? If we could only put a million infants healthier and happier every year, I think it would be about the best social investment we could possibly make. Let's have in our leading doctors to discuss this thing practically. I've been thinking about it for a long time, and I'm ready to go the limit to put a strong 'Child Health' organization in the field."

The best doctors in America were called into the conference, and with Mr. Rockefeller they plotted to wipe out rickets, diphtheria, and adenoid infections—the three diseases most dangerous to child life. It was agreed that the field of endeavor should be international, Canada, Brazil, Porto Rico, and many rural districts of the United States being selected as the areas most in need of baby clinics. No money was to be spared, and the most advanced methods of "baby culture" were to be employed in carrying physical salvation to half a million babies every year. Actually fifty million dollars was voted to begin the work.

I happened to be at a rural county fair in Quebec when I saw my first Rockefeller "Child Health Station". It was a large circular tent, specially equipped with medical instruments. Two experts and a very efficient personnel of Dr. Rockefeller doctors and nurses were busy examining the children of the French Canadian habitants, inquiring carefully into the physical defects of their bones, lungs, and throats. Treatments and diet were prescribed in simple terms to the humble peasant folk, and I was particularly struck with the tact and intelligence shown by the Rockefeller doctors in explaining the dangers of rickets and adenoids in Dr. Lord's and Dr. Osborne's dialect. Hypophosphites of lime, cod liver oil, and beef extract were not the hands of impoverished parents, who were mighty glad to get these bone-builders for their rachitic children. My wife was especially interested in the exhibition of baby cooking which was being given by a registered nurse at the back of the tent. After watching this expert dietitian cook spinach and carrots with a very small quantity of water, my wife discovered that she had been wasting the precious mineral salts and vitamins in our child's vegetables.

"YOU might as well be feeding your child boiled grass as to give him vegetables from which the vitamins have been drained or boiled away," was the nurse's reply to my wife's interested query. "Here is a small leaflet, prepared by our doctors, telling how to retain all the flavor and food value in cooking vegetables. I'll guarantee that your child will love spinach if you follow the few simple directions in this leaflet."

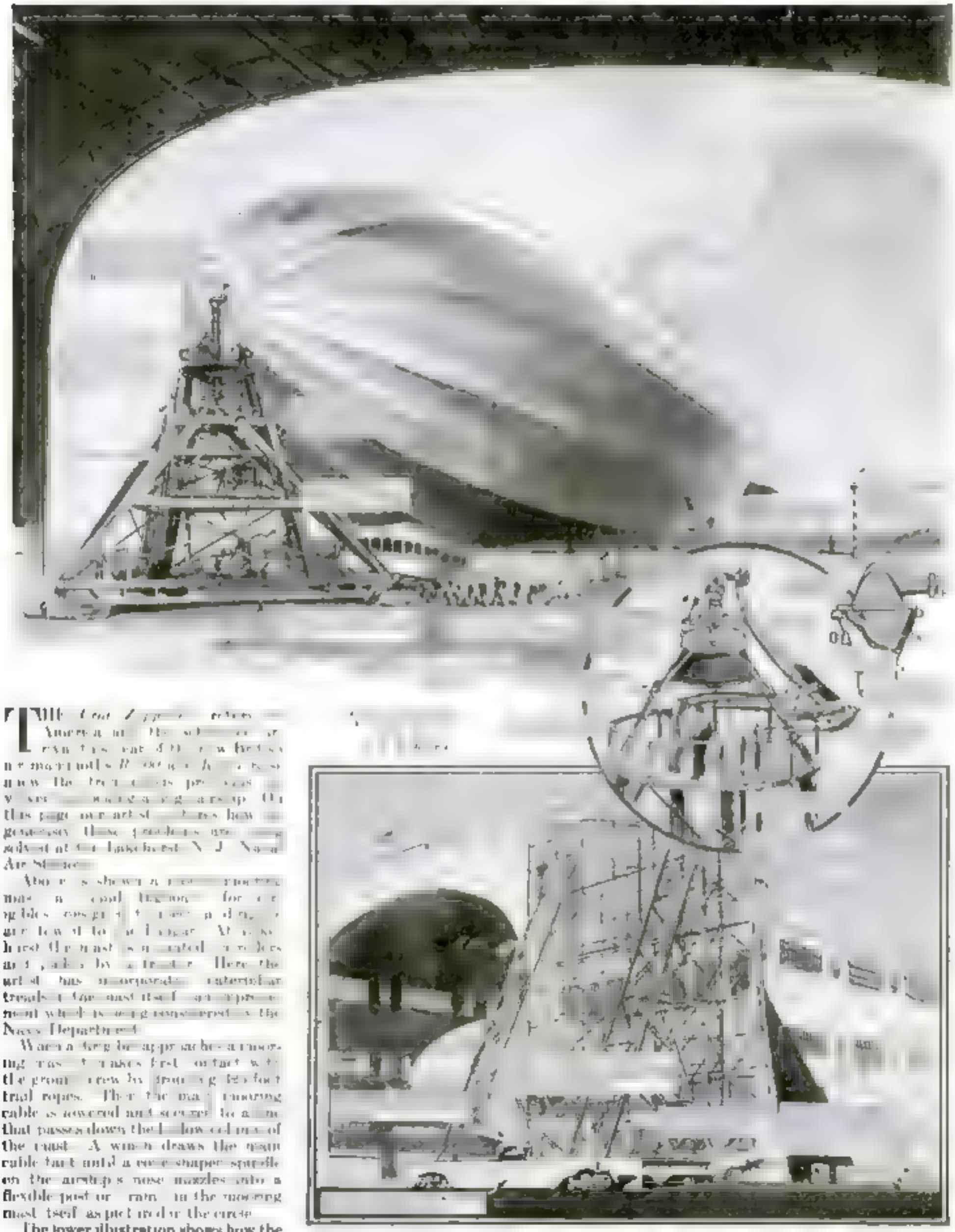
Multiply this incident by a million, and you will begin to realize the extent of Mr. Rockefeller's campaign for healthier children. For although the Health Tent moves on to the next county when the fair is over, the medical service does not! In close cooperation with local officials, the Rockefeller Foundation supports more than 2,000 permanent health bureaus in the western hemisphere. District nursing, free clinics, and medical service, lectures, and literature are all a part of the health program that sprang out of John D.'s desire "to do something for the babies."

SUPPOSE you live, as I did for a time, in the hookworm belt of the South. So anyone who has seen the stunted and deformed hookworm victims at close range, and has watched them dragging out a living death, the work of the Rockefeller Foundation seems little short of miraculous. For within the last dozen years the hookworm menace has been broken, and millions of sufferers restored to health. The campaign against hookworm really began in 1907 when John D. Rockefeller was making an extended tour of the South. In the hilly back counties of Tennessee, and on the sandy plains of Georgia and Alabama, Mr. Rockefeller saw with his own eyes the pitiable condition of a half million hookworm victims. He could not forget the blasted children and their stoken-eyed parents, so in 1909 he established the Rockefeller Sanitary Commission to study conditions in six southern states.

THE investigators found that the hookworm was a tiny parasite which entered the human body through the soles of the feet, worked its way into the blood stream, and finally lodged in the intestines of its victims. So the first thing the Rockefeller Commission did was to provide shoes for every barefooted child and field worker in 113 counties of Alabama, Georgia, and Tennessee. Even cheap sandals would have been a protection, but Mr. Rockefeller directed his agents to give away half a million pairs of good strong shoes as the first maneuver in the campaign against hookworm.

But what about the hundreds of thousands of persons who already had hookworms inside their bodies? I knew plenty such, especially among the poor whites or "crackers" of South Carolina, where I was making an industrial survey. One of the worst cases I ever saw was the father of a large family who was a human wreck after suffering from hookworm for ten years. I remember taking him to one of the field hospitals set up by the Rockefeller Commission. (Continued on page 118)

How Air Giants Are Parked



Each huge hangar door rests upon a massive concrete platform running on railroad tracks and driven by four twenty five horsepower motors, geared to the car wheels. They open or close a door in twelve minutes. Above, in circle, dirigible is shown being restocked with gas fuel, and water while moored to the mast.

The lower illustration shows how the ponderous 1,250 ton doors of the Lakehurst hangar slide open.

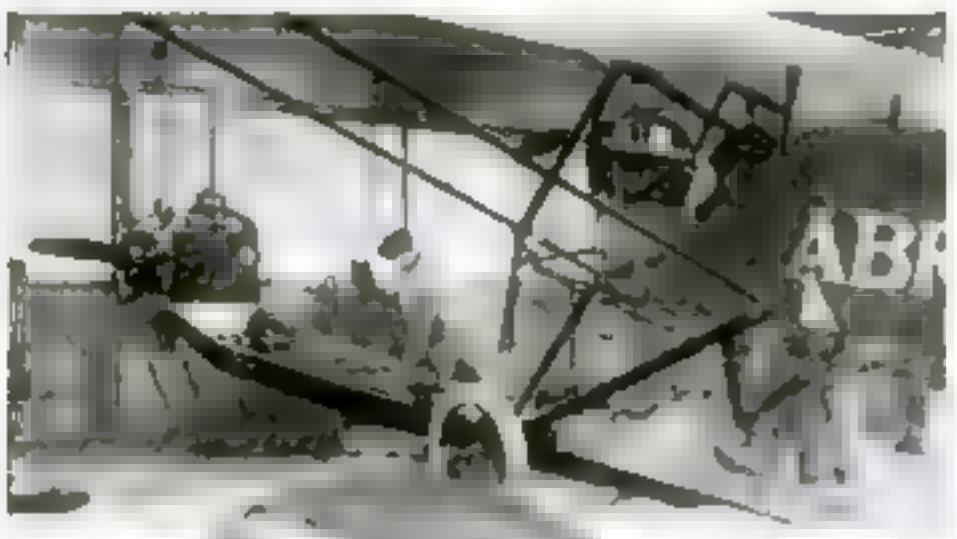
Balloon Racers Set 900-Mile Record

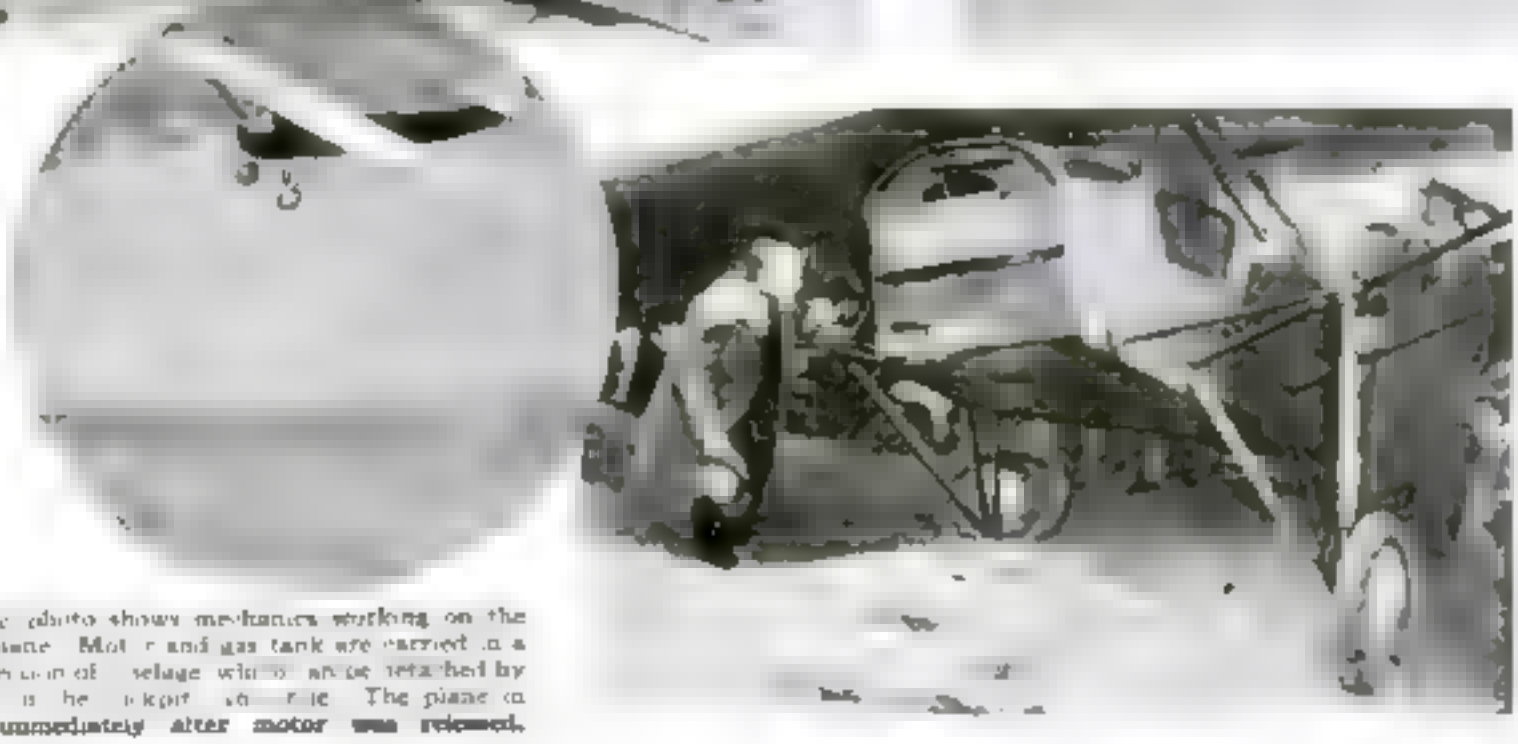
Drifting more than 900 miles in Navy No. 1 balloon, Lieut. T. W. G. Settle right pilot, and Ensign Wilfred Bushnell, his aide, recently broke all balloon distance records to win America's national elimination race. Starting from Pittsburgh, Pa., they landed near Charlottetown on Prince Edward Island.

Just before the start of the national race a dozen balloons hung in festoons in the Pittsburgh stadium. The winner, last to leave, was in the air about forty-three hours.

The start of the race. Two of the balloonists, Arthur O. Schlosser and E. J. Hill, pilots of the Detroit *Times* balloon, were lost for two days in the Adirondack Mountains.

If Motor Quits, This Plane Drops It—And Glides





The top photo shows mechanics working on the novel plane. Motor and gas tank are carried on a lower section of fuselage which is detached by a lever in the pilot's cockpit. The plane on right immediately after motor was released.

In a recent spectacular test before Army and Navy officials at Anacostia Airport, California engineer demonstrated his safety plane invented by Joaquin S. Adrian. Launched to a height of 2,000 feet, dropped its motor and gasoline tank and started to earth as a motorless glider. In landing the plane nearly turned over, but Reed Whalen was unhurt and the plane was undamaged. Above: The plane taking off for the test flight. At left: The motor and gas tank falling after being released from the machine.

Climbs 722 Feet Nearer the Sun

World's highest flyer—Lieut. Apollo Soucek, Navy pilot

Ready for the supreme test of stamina and courage.—Lieutenant Soucek in the cockpit, wearing oxygen mask and electrically heated goggles pierced with pinholes to see through when frost covers them.

How Daring Navy Pilot Defied Thin Air and Bitter Cold to Reach an Altitude of 39,140 Feet, and Set a World Record

By JOHN E. LODGE

NEARLY seven and a half miles above the Naval Air Station at Washington D C , a diminutive flying craft tilts along the top of the sky Pointed up at a precarious angle, its nose fails to rise. The wings beat vainly against the thin air In the cockpit, Lieut. Apollo Soucek, daring Navy flyer begoggled and swathed in furs, gasps oxygen from a tube and fights with the controls to lift the balky craft a few inches higher. On the altimeter dial before him, a needle creeps up to the figure "40,000."

One more try The nose of the plane, hoisted too far, whips over Instantly the plane is spinning crazily to earth. Soucek lets go the throttle. Two thousand feet below, the plane comes out of the spin and begins to descend in great spirals. At last it's down—with a new world's altitude record

Two days later a checking-up of the height-registering barographs that were carried, required by the rules, revealed that Soucek had reached an exact altitude of 39,140 feet, exceeding by 722 feet the record of 38,418 feet, set in 1927 by Lieutenant C. C Champion, U S. N in the same Apache plane.

When Lieutenant Champion made his record at Washington he was just at the peak of his climb when the motor went to pieces. Flames enveloped the plane. By diving and side-slipping, he managed to put out the fire and land with the record, very nearly at the price of his life.

Undaunted by such perils, Lieutenant Soucek prepared calmly for his flight into the region of thin air where the thermometer drops to sixty or seventy degrees below zero. While officials inserted the barographs and mechanics the forty gallons of gasoline in his tuned-up plane, he donned his flying suit, boots, and mittens. Then a Naval Air Station surgeon plugged his nostrils so that he could breathe only through his mouth. From his forehead hung a pair of electrically heated goggles, pierced with six pinholes to see through when frost should cover them.

All was ready he hopped in. A short run of seventy five feet and the plane was in the air In fifteen minutes it shrank to a speck and vanished from the sight of watchers below

Up in his tiny plane Lieutenant Soucek was witnessing what was perhaps the most wonderful panorama ever seen by man Through the clear air he could see practically the whole state of Maryland and a large slice of Virginia spread out beneath him. Soucek didn't feel the cold but he knew by his sticky controls that the oil was freezing His senses were becoming numbed Then a cloud crossed his eyes frost forming on his goggles. Only the tiny pin holes to see through, now. His eyes hurt; his tired arm was cold from grasping the frigid control stick He tucked his hand behind the cowling of the cockpit to keep warm and pulled the lever harder to raise the ship.

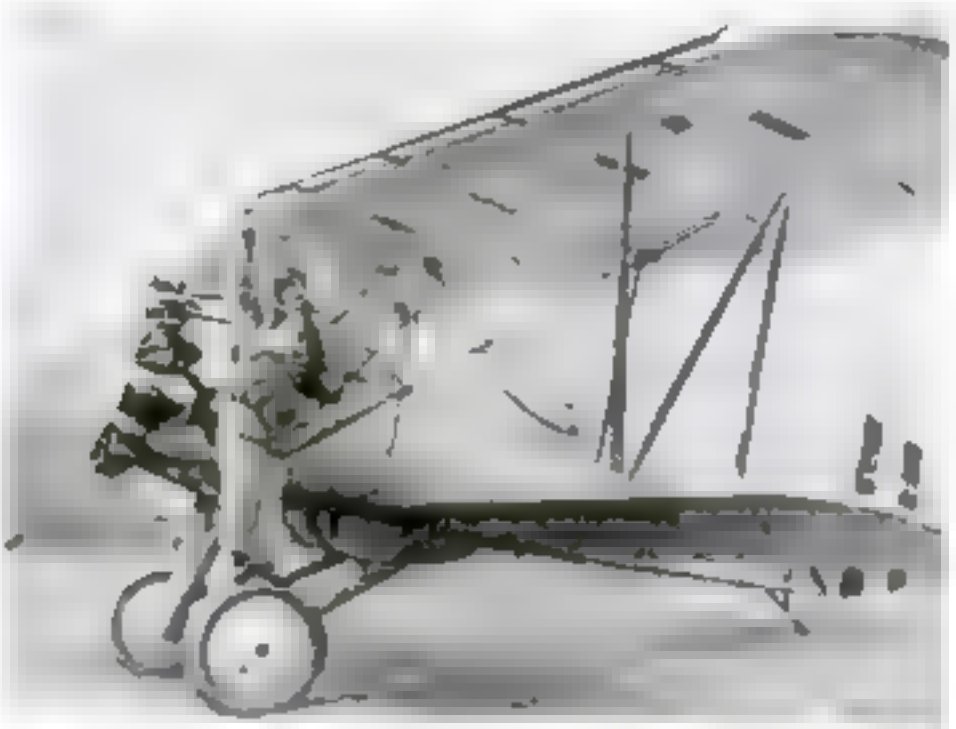
He grasped the stick with his knees, using one hand to hold the supercharger air tube and to raise his goggles to look around. Slowly the altimeter dial crept around with Soucek growing impatient and weak. At last it touched 40,000 —and then the plane hesitated, stood on end, and whirled toward the earth Soucek had climbed nearer the sun than any other mortal

Above: a pilot taking the altitude climb test at U S Army Air Corps [illegible] and see how high he can fly without oxygen before he loses consciousness At right: Oxygen apparatus [illegible] for high altitude flying

Keeping Pace with Aviation

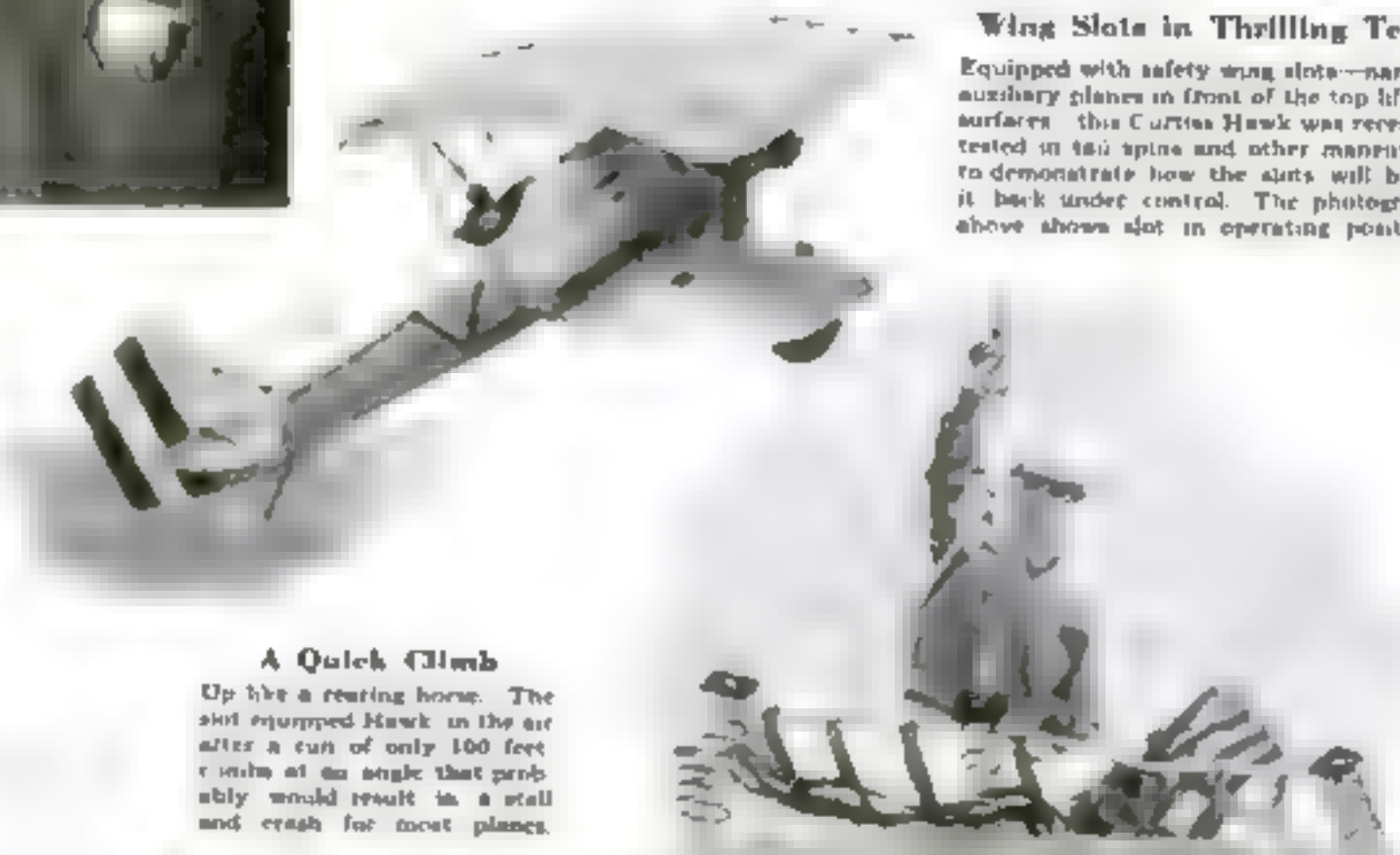
Radio Signal Lights Tell Altitude

Like a traffic signal, a new radio echo altimeter developed by Dr E F W Alexanderson, of the General Electric Company flashes green, yellow, and red lights to warn an airplane pilot of his height above the ground. When the green light appears on the panel in the cockpit the pilot knows he is 250 feet high, yellow light 100 feet and red light, fifty feet Photo shows Dr Alexanderson, at right demonstrating the instrument



Wing Slots in Thrilling Test

Equipped with safety wing slots—narrow auxiliary planes in front of the top lifting surfaces this Curtiss Hawk was recently tested in tail spins and other manœuvers to demonstrate how the slots will bring it back under control. The photograph above shows slot in operating position



A Quick Climb

Up like a rearing horse. The slot equipped Hawk in the air after a run of only 100 feet climbs at an angle that probably would result in a stall and crash for most planes.

Byrd Should Have One

A new electrically heated flying suit and its inventor Dr B. R Charles, of Los Angeles, Calif. In the padded lining is embedded a mesh of copper wires, carefully insulated. Wires also run to gauntlets and boots. Current is supplied through a cord plugged into dash and connected with storage battery.

Copied from Bats

Called the "flying surfboard," this curious machine has but one wide wing, with motor, cabin, and landing gear slung beneath its center. It was designed by Earl E. McClary, of Long Beach, Calif., after a study of flying bats. Ailerons are attached to sides of wing; elevator and rudder operate at trailing edge.

Plane Lands by Parachute

In a spectacular experiment at Santa Ana Calif a 3,600-pound biplane piloted by Capt. Roscoe Turner released a huge parachute which arrested it 5,000 feet Above Releasing apparatus on upper wing. Left Opened parachute with plane suspended.

Two-Way Phone Service for Airplanes—Dirigibles to Meet in Race—Amazing New Records and Inventions

SO SUCCESSFUL have proved experiments in two-way radiophone communication between pilots of speeding mail planes and ground stations that the system is now to become a regular service on the 800-mile western leg of the transcontinental route between Chicago and San Francisco. Twelve ground stations in seven states will keep in touch with pilots at all times, and advise them on weather conditions ahead. A somewhat similar system has been in use in the East for some time, but the pilots have been able only to listen to instructions and not to reply.

The revolutionary innovation will enable a pilot to talk with ground officials even if he is 12,000 feet above sea level and lost in the clouds.

The twelve ground stations already built or authorized are at Oakland and Sacramento, Calif.; Reno and Elko, Nev.; Salt Lake City, Utah, Rock Springs and Cheyenne, Wyo. North Platte and Omaha, Neb. Des Moines and Iowa City, Iowa, and Chicago. Thirty-five planes flying over this route will carry the radiophone equipment.

THE phone service will assure safe landings in fog and will help pilots to avoid bad weather conditions when possible, and to pilot a straight course through haze and storms. What is said to have been the first instance of the use of the plane radio in emergency occurred recently when a mail pilot, E. F. Allen, developed engine trouble between Reno, Nev., and Oakland, Calif., just before crossing the Sierras. By phone he summoned a relief plane to meet him at an emergency field a short distance ahead. Then he landed. The relief plane carried the mail through, saving three hours' delay.

Recently the Bell Telephone Laboratories developed a new type of airplane radio receiver remarkable for its small, twelve-pound weight, to be used in two-way communication. This system was demonstrated at Detroit, where a special program was transmitted from a plane and broadcast through a chain of local stations.

76,000 Miles of Airways

SEVENTY-SIX thousand miles of air routes are in actual operation today in all parts of the world, according to a recent estimate of Brig. Gen. P. R. C. Groves, British Air League official. Of these, the American transcontinental line between New York and San Francisco is termed the most completely equipped.

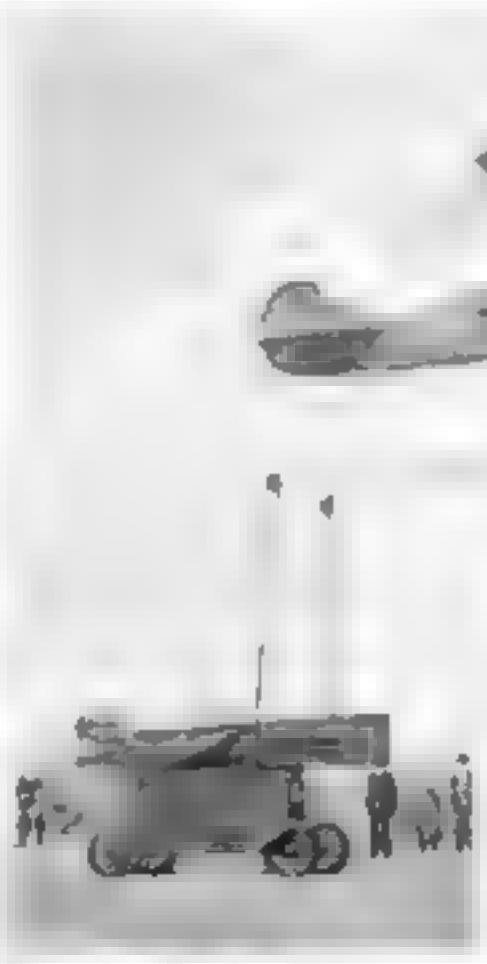
In America alone, more than twenty-one thousand miles of airways—including recently established routes from Florida to Porto Rico and Panama—are now in operation, Department of Commerce figures show. This is nearly a tenth of the total railroad mileage in the United States.

Air Mail Records Broken

FLYING with the mail at 198 miles an hour is the unparalleled record made recently by a Canadian pilot, who covered the 330 miles between Toronto and Montreal in 100 minutes. This beats the American record of 196 miles an hour, established between Kansas City and Dallas.

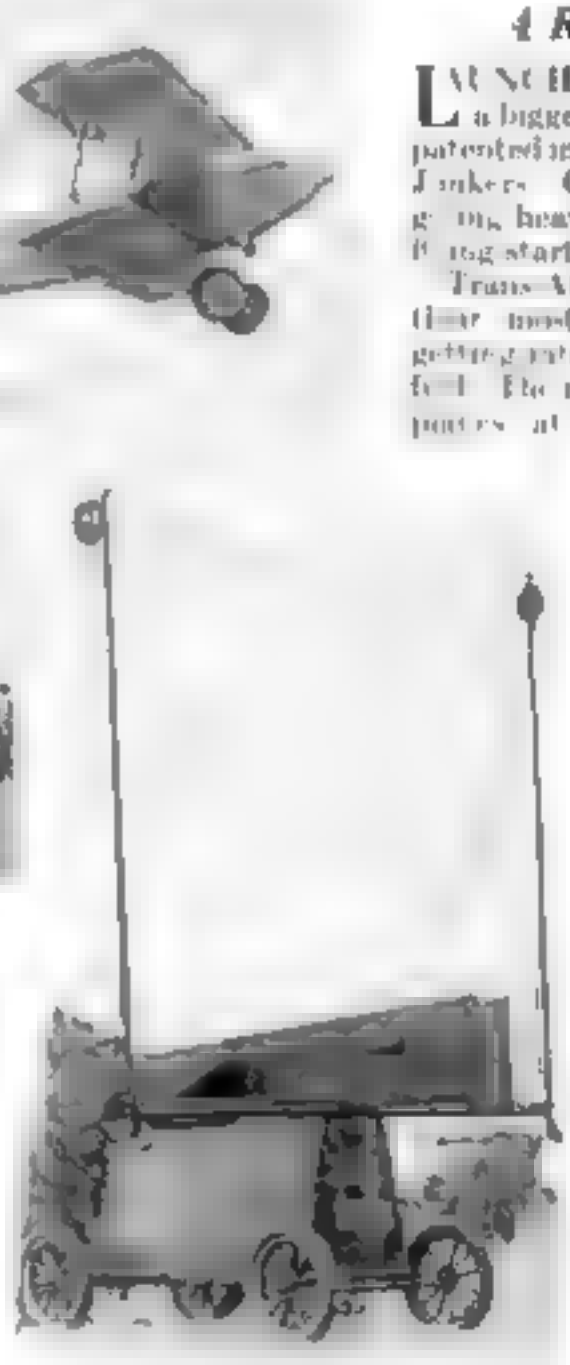
Such tremendously swift hops reflect efforts to speed up air mail service. Last fall the U. S. Post Office Department announced its intention to speed up the 100-mile-an-hour schedule then generally in effect, and recently eight hours have been cut from the time of the transcontinental service. Meanwhile new records are being made almost daily.

Robert Hopkins, National Air Transport pilot, recently landed in Cleveland, O., just one hour and forty minutes after taking off from Chicago—establishing a record for the flight of 191 miles an hour, average speed. Not long before, Capt. Hal Holloway and Gilbert Clarke, assistant pilot, flew a Western Air Express plane between San Francisco and Los Angeles, 365 miles, at an average clip of 178 miles an hour. Long-distance records for speed include a recent 1,000 mile night flight from Dallas to Chicago at 150 miles an hour, and a record journey of the cross-continent mail from San Francisco to Chicago at a 132-mile average. The time was fourteen hours and fifty-one minutes, against sixty three hours for the fastest train.



Catches Fuel on the Fly

A novel fishhook refueling method was tested recently at Roosevelt Field, N. Y., by Lieut. H. D. Cha... in preparation for an attempt to beat the 37-hour endurance record held by the Army plane Question Mark. The plane would glide down over a target mounted on an auto, hook and snare up with a dangling cable and gasoline. A hook on the landing gear at the rear would swing between uprights on the target. At the same time the target would pull the cable to which the gasoline tank is attached.



A Real Flying Start

LAUNCHING a plane from the back of a bigger one is the novel plan recently patented in the United States by Dr. Hugo Junkers, German aircraft builder, for getting heavily-laden machines literally a flying start.

Trans-Atlantic flyers have said that their most perilous moments were in getting into the air with a heavy load of fuel. The new device would start off such planes at the desired altitude. The auxiliary plane would then return to its field.

Until the moment of release from the tri-motored plane that bore it aloft, the smaller craft would be fastened by a spike to a stage on the big craft's back and chocks would be placed before and behind the smaller plane's wheels. At the moment for the aerial take-off, the large craft would slacken speed, and the small one, tilting its rudders or ailerons, would sail off.

Sky Luxury—Even Refrigerators!

AN "AIRPLANE chair," an 'hourometer' to clock a plane's flying time, and device refrigerators are among the novelties for air travel in the latest bumper crop of inventions.

In the airplane chair, the Pullman seat of railroad trains has been modified by a New York manufacturer to meet the special needs of air voyages. The result is a strong, light, and comfortable seat that adjusts itself automatically to any position of the body. It even flattens into a couch if desired.

Two Oakland, Calif., inventors have devised a flying time recorder that shows the actual number of hours a plane is in the air. Electric contacts are attached to the landing gear, and an electric clock automatically starts when the wheels leave the ground and stops when they touch it again.

"Dry ice," otherwise known as carbon

dioxide "snow," is used instead of ordinary ice in refrigerators on passenger planes now operating over a recently established Albany-Lake George-Montreal airway, on which luncheon is served in the air. This white, intensely cold powder is particularly suitable for airplane use because of the small weight required to cool the refrigerators.

When You Take a Ride

IS THE plane airworthy and the pilot capable? Those two questions are good ones to ask before you take an airplane ride, and they are easily answered.

First, look on the plane's wings or rudder for its Department of Commerce identification number. Prefixed by "C" or "NC" (such as C-136 or NC-647), this signifies that the plane has passed rigid Government tests. Then ask the pilot if he is licensed to fly. If there is any doubt, demand to see his license.

Pilots who cannot exhibit either a "transport" or a "limited commercial" license are breaking the law if they take up passengers for hire, and should be reported to the nearest authorities. Together with unauthorized planes, they account for most air casualties.

First Race for Dirigibles

A RACE for dirigibles, the first in air history, may be one of the features of the National Air Races and Aeronautical Show to be held in Cleveland, O., late in August. Tentative plans also call for a contest among blimps. Possible entrants would be dirigibles from the Army base at Langley Field, Va.; the Navy base at Lakehurst, N. J., and probably one or more of the five "pony blimps" of the Goodyear Zeppelin Corporation, Akron, O., of which two have been flown for some time and three are now being built.

The Navy's New Carrier

IMPORTANT departures from the type of huge airplane carriers exemplified by the 33,000-ton *Lexington* and *Saratoga* will be made in the Navy's newest carrier, on which construction soon will start, according to reports from Washington. It will be less than half the size of one of these enormous floating air fields, yet will carry as many or more planes—seventy-two at least. Whereas the *Lexington* and *Saratoga* are armed with eight-inch rifles and five-inch antiaircraft guns, and are heavily armor-plated, the new vessel will have only a few antiaircraft weapons. Armament and speed have been sacrificed to plane-carrying ability in the design, and the carrier will rely principally upon its planes and upon the guns of other ships for defense.

One reason for the reduction in size is the limitation of naval tonnage under the Washington treaty ratio.

U. S. to Alaska—Nonstop

FIRST to travel without stop between the United States and Alaska, Noel Eckman, Seattle, Wash., aviator, recently landed at Juneau with two passengers. He had covered 650 miles from Seattle in eight hours, pioneering over a route that may soon be opened to regular air traffic.

The Army Air Corps blazed the Alaskan trail in 1920 when a squadron of Army flyers reached Nome, after many stops en route. Today three air line companies plan air passenger service between Seattle and southern Alaska, using seaplanes and amphibians, in trips completed between dawn and dusk. Steamships require three and a half days.

Molding Plane Fuselages

TIME is saved in building the light streamlined fuselages of airplanes by a new method recently developed in a

New time-saving process of making fuselages. A right [illegible] the halves are molded

Burbank, Calif., plant. A concrete form gives the exact shape of one half of the fuselage. Into the form, three layers of plywood, with a layer of casein glue between, are placed. Then a rubber air bag, shaped so as to fit the depression, is inserted and a cover lowered and bolted securely in place.

The bag is expanded until it exerts a pressure of from fifteen to twenty pounds a square inch. After eight hours of this pressure, the solid shell of the half fuselage is ready to be fitted to the plane's skeleton framework of laminated spruce rings.

The former method of producing these bodies was slow and costly. Over a form strips of veneer were laid diagonally. Each strip had to be glued or tacked separately to the form. Two other layers, laid at an angle to each other, were built up with angular care. Over all, fabric was glued as a binder.

Greatest Airship Hangar

TESTS of scale models in the great wind tunnel at the Guggenheim School of Aeronautics in New York have helped design the greatest airship hangar in the world, now under construction at Akron, O., to house the building of the Navy's two new 6,500,000-cubic-foot dirigibles.

Streamlined design similar to an airplane's will be a feature of the new hangar, whose dimensions are so immense—it is to be 1,200 feet long, 300 feet wide, and 200 feet high—that the pressure of the winds would otherwise tear it to pieces. It will look, with its rounded ends, like a giant tortoise.

In the sun's heat the mammoth building will swell visibly, due to the expansion of its steel members. Consequently ordinary rigid foundations are out of the question. Instead, the center of the hangar alone is anchored and the outer ends may slide back and forth on huge rollers.

The hangar will be large enough for fourteen separate football games to be played inside it at once. Mammoth doors at each end, weighing 800 tons each, will be opened and closed by special electric motors and electrohydraulic brakes. They are made in curved "orange peel" sections and are flexible.

11 Cents a Mile by Plane

IT COSTS a traveler eleven cents a mile, on the average, to go by air according to a survey just completed by a Western air line. If he should buy a one-way ticket on every regular passenger air line in the United States, he would pay $1,427 for his 12,917-mile journey—an average of approximately eleven cents per mile.

On paper, this is considerably more expensive than railroad travel, which averages a little more than three cents a mile. Actually, however, there are many factors that tend to equalize the apparently disproportionate cost, the survey points out.

On most fast trains an extra fare is charged over long distances. Further, the additional cost of a Pullman chair or berth is not included in a railroad ticket, nor is the taxi fare to and from terminals. Usually both are included in the air ticket price. Moreover, the air mileage between any two cities is often considerably less than the railroad mileage. Lastly, there is the fact that airplanes are three times as fast as trains.

A 5,000-Mile Airway

WHEN a huge Armstrong-Siddeley airplane descended at Croydon Airdrome, London, the other day, with five passengers and 15,000 letters aboard, it marked the opening of Britain's greatest air line. The plane had completed the last lap of a 5,000-mile flight from India, completing exactly two minutes ahead of schedule the first trip over the newly projected route.

Besides prominent Air Ministry officials, there were two passengers aboard who had come all the way from India.

Ferman Stone, American mail pilot, in plane equipped for practicing blind flying. A hood covers pilot's cockpit

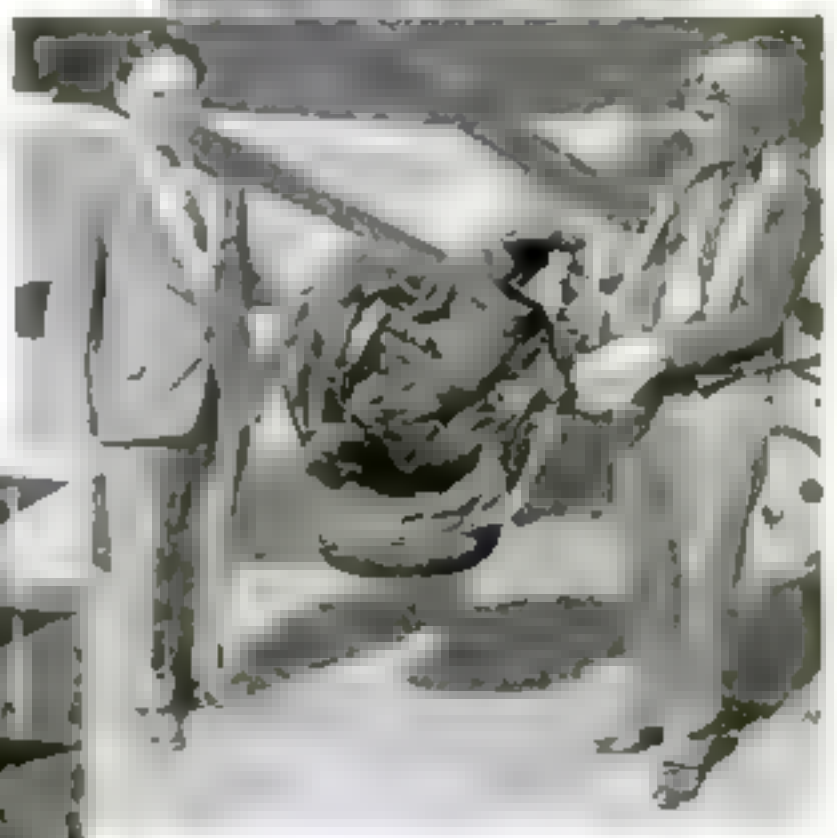
Teaching Pilots to Fly "Blind"

A training plane of the Parisian School of Blind Flying in France. The pilot, covered by a hood, is maneuvering entirely by his instruments. The instructor, in rear cockpit, raises his arms to show he has released controls. These pilots learn to fly in the best weather with as much confidence as with full visibility

Train in bench. Cut-away plane for practice in flying by instruments only. The instructor, in rear seat, varies instrument readings, and the pupil, operating controls, must keep his machine

Did you ever try to drive your car without seeing the road? These pictures tell how pilots learn to fly *blind*—and other wonders in the air.

Luxurious Air Yacht. Latest of Dornier creations is this graceful flying boat with cabin for eight passengers. Driven by a 550 horsepower engine with pusher propeller above wings, it is 74 feet long. Its speed is 115 miles an hour. A kitchen and sleeping quarters permit week-end trips of long cruises in comfort



Hundred-Passenger Plane. This mammoth Caproni flying boat, largest airplane ever built, is undergoing tests in Milan, Italy. Nine wings, arranged as triplanes in tandem, are to lift the huge houseboat-like body. Benches along the cabin provide seats for 100 passengers—more than the capacity of the dirigible *Graf Zeppelin*. Motors are at front and rear

Parachute-Seats for Passengers

In the cabin of a transport plane a dozen passengers are seated. Suddenly the plane is enveloped in flames. The pilot moves a control and the passengers, still in the seats, drop through trapdoors in the floor of the cabin. As they fall, parachutes automatically open, carrying them to safety. That is the idea of this new safety parachute-seat invented by Floyd Smith (left). In recent tests at Trenton, N. J., two jumpers safely landed from a height of 1,000 feet. Top photo shows trapdoor release

Why Everyone Has a Double

Recent Investigation Reveals Astonishing New Facts About the Blood Ties Between People Who Look Alike

By MICHEL MOK

ONE morning, about a week after the inauguration of President Hoover, a political leader was walking to his office in Philadelphia when he saw a lean, medium-sized, sandy-haired man, dressed in a long black overcoat, coming toward him. Nonplussed, the politician stopped dead in his tracks. Then, delighted, he went up to the man with outstretched hand.

"Why, Mr. Coolidge!" he exclaimed. "This is, indeed, a pleasure. What brings you to Philadelphia?"

Smiling broadly but showing no surprise, he of the black overcoat replied: "I am sorry to disappoint you. I am not Mr. Coolidge."

The man was Charles Hotz, a Philadelphia waiter, who bears such a striking resemblance to Coolidge that he has been mistaken for him many times. Recently a motion picture company offered him the job of impersonating the ex-president in a patriotic film. If he accepts, it won't be the first time Hotz's presidential face has proved his fortune. He is said to have accumulated a neat little nest-egg by saving generous tips from persons who enjoyed having their chop served by a "dead ringer" for the President of the United States.

Hotz is one of a long line of presidential "doubles." Lincoln, Cleveland, Roosevelt, Taft, Wilson, and Harding all have had their facial counterparts. Thus far, no facsimile of President Hoover has appeared, but no doubt one soon will.

YOU and I, too, have our facial duplicates. Science tells us it is one of the whimsies of Nature to create almost identical human countenances in pairs and sometimes by threes and fours.

In a study of this strange state of affairs, Dr. van Bemmelen, a professor in the University of Groningen, Holland, has reached the theory that doubles are blood relations, though the family connection is often remote. In many instances of striking resemblance, he established a common ancestry.

A New York barber, Frank Valentino, looks so much like Mussolini that he recently entered vaudeville with an act in which he impersonates the Italian premier who, reports say, has expressed displeasure at the stunt. Are the barber and Il Duce distant cousins?

Absolutely, says Dr. van Bemmelen. He has calculated that, going back eight generations, a man has 256 ancestors, and in thirty generations 1,000,000. Hence there would not have been enough forebears to "go 'round" unless many of us have the same ancestors in common.

IT PROBABLY wouldn't take Professor van Bemmelen long to demonstrate that Sir Henry Whitehead, British textile manufacturer, and King George of England are connected by family ties. Sir Henry resembles the British monarch so closely that, arriving in New York some months ago, he had difficulty convincing ship-news reporters that he wasn't the King incognito.

It might be somewhat harder, though not impossible, to establish blood relationship between Judge S. H. King, of Tulsa, Okla., and Lloyd George, the British statesman. The resemblance is so striking that the judge's friends have nicknamed him "the little Welshman." Not long ago, the judge appeared at a Tulsa festival, dressed in regal costume as "King Petroleum." He sent his picture to Lloyd George, who is said to have enjoyed a good laugh.

. . . Even the Ex-President Has a Double—Charles Hotz, Philadelphia Waiter

Which is . . . Mussolini? The Other Is Frank . . Valentina, N.Y. Barber . .

Rudolph Valentina, Late Screen Star, . . And Thor de Mindszenty

Other fairly easy cases would be those of Charles Hoyt, the head of a New York advertising firm, who is a "ringer" for Will Rogers, the humorist, and of Tibor Mindszenty, a young Viennese actor whose startling likeness to Rudolph Valentino caused some superstitious residents of Hollywood a few uneasy moments when he arrived at the movie colony in quest of the late "sheik's" job.

MANY of the surviving friends of Mark Twain have been shocked by the appearance of Ethelbert Stewart Commissioner of Labor Statistics of the U. S. Department of Labor, Washington, D. C. With the same flowing hair, squinting eyes, bushy eyebrows, and unruly mustache, he reminded them forcibly of the late writer's famous comment, on the occasion of a prematurely published obituary notice, that the report of his death had been "greatly exaggerated."

Even Dr. van Bemmelen, however, might have been at a loss to account for the proverbial "two-peas-in-a-pod" resemblance between Theodore Roosevelt and a modest frame maker in Florence Italy. Mrs. Roosevelt was told about the extraordinary similarity. Traveling in Italy, she made a special trip to Florence to see the man. She was struck speechless when the stocky shopkeeper with his eyeglasses and drooping mustache welcomed her.

The common ancestry theory receives some support from recent experiments of a German physiognomist which show that facial duplicates may be found in persons who lived centuries apart. He took a picture of Gene Tunney, retired heavyweight boxing champion, and, by painting in flowing locks and white neck ruffles of the early nineteenth century costume, changed it into an excellent likeness of the great German musical composer, Ludwig van Beethoven! A periwig, a tricornered hat, and a uniform coat and—presto! a photograph of Henry Ford became a "portrait" of Frederick the Great! The German offered these examples in proof of his contention that resemblance of features is no guarantee of similarity in character.

Another striking instance of resemblance across the ages is that of Winston Churchill, the English statesman, who looks so much like the bust of Titus emperor of the Romans from A. D. 79 to 81, in the British Museum, that he might have posed for it.

THERE are numerous examples to support the theory that similarity of countenance is not a guide to character. A humble moujik was the double of the late Czar Nicholas of Russia, and a petty swindler of Count Leo Tolstoy, the great novelist. A delicatessen dealer a dentist and even a chimneysweep have been mistaken for former Kaiser Wilhelm of Germany. And half a block away from the roar of the Grand Central Terminal in New York City, a "dead ringer" for Thomas A. Edison wears a porter's badge and pushes a baggage truck.

Of presidential likenesses, that of Judge Charles Bull, of Reno, Nev., to Abraham Lincoln is probably the best known. To make the resemblance even more complete, the judge wears his beard in the Lincolnian style.

President Wilson, who was said closely to resemble both William Pitt the eighteenth century British statesman, and Joseph Chamberlain, Queen Victoria's Colonial Secretary at the time of the Boer War, enjoyed the luxury of several facial counterparts. A tremendous commotion was caused in New York City in the spring of 1916, when one of them, Deputy Fire Commissioner W. Holden Weeks, of New York, dropped dead in the street. Grief-stricken crowds with bared heads blocked the thoroughfare. So pronounced was the resemblance to President Wilson that police had difficulty in convincing the people of their error.

Fiction abounds with incidents involving doubles and mistaken identity, but a few months ago an international furore was occasioned by a real case of this character. A young woman calling herself Madame Anastasia von Tschaikowsky and claiming to be the Grand Duchess Anastasia Nicolaievna, daughter of the late Czar Nicholas of Russia, arrived in this country to be the guest of Mrs. William B. Leeds, the former Princess Xenia of Russia.

The girl had been dragged out of a Berlin canal by the police after an attempt at suicide. Despite statements from the Soviet government that the Czar's entire family had been put to death, Mme. von Tschaikowsky stoutly maintained that she had escaped.

IN THIS country, she was identified as the Romanoff princess by Gleb E. Botkin, son of the American physician to the murdered emperor who spent his childhood playing with the imperial children at the Petrograd court. But the surviving Romanoff clan in Europe, headed by the late Grand Duke Alexander, repudiated Mme. von Tschaikowsky's claims. The Grand Duke, a spiritualist, said he believed the mysterious stranger was not an impostor, but that the Grand Duchess Anastasia's spirit had found refuge in a body which so closely resembled her own.

Such puzzles as this will continue to intrigue us so long as Nature persists in duplicating human features.

Not Two Poses of King George; One Is Sir Henry Whitehead, London Peer

Lloyd George and His Double-Judge S. H. King of Tulsa, Okla.

Will Rogers' Grin Has Its Counterpart in . . . That of Charles Hoyt

Has Fame Made Lindy "High Hat"?

One of His Most Intimate Friends Gives You a New Slant on the Lone Eagle As He Is After Two Years

By DONALD E. KEYHOE

Spirit of St. Louis soaring over the countryside during Lindbergh's tour of the United States—a beautiful photo taken by the author from an escort plane

COLONEL LINDBERGH has done more than any other one man to arouse popular interest in aviation. In less than a day and a half, in his flight to Paris, he advanced public faith in airplanes and air travel by years. And so, two years after that epoch-making flight, POPULAR SCIENCE MONTHLY presents on the following pages the great story of his vivid life in pictures in a special eight-page rotogravure section.

TWO years ago Charles A. Lindbergh touched foot on United States soil for the first time after the famous trans-Atlantic flight. Stepping ashore at Washington, he found the whole nation acclaiming him wildly. His name was on every lip in the capital, it echoed and spread by radio, by telegraph, and by the presses that roared overtime describing his every act and word. And America roared approval of the President's summary: "Modest, congenial, frank, intelligent, purposeful, quick." I take from a careful Army report written before Lindbergh was known to the world.

Two months ago Charles A. Lindbergh again touched earth at Washington, landing his airplane at Bolling Field for a hasty conference with Major Thomas Lanphier before hurrying on to meet the ship bearing Ambassador Herrick's body. As the Colonel landed in the muddy field Major Lanphier ran out to the plane. Instantly a group of Lindbergh's admirers rushed out also, intent on surrounding him to shake hands and to obtain autographs.

The engine was still running, for Lindbergh expected to take off immediately. Fearful of a mishap almost an obsession since he saw a man killed by a propeller—Lindbergh hurriedly opened his throttle to taxi to a safe distance. The engine roared, sending a blast of air back of the plane. The onrushing group was spattered with mud and water from the poorly drained field.

IN AN hour Lindbergh's name was again on the capital's lips, again an echo grew and spread by radio, by telegraph, and by the newspaper presses which ground out the story, "Lindbergh splashes mud on his admirers—and himself."

Comments came from all over the country. Several editors of big dailies were wrathful. "Needs a lesson in courtesy," "after two years the hero shows feet of clay," "someone should take him aside and tell him the meaning of courtesy"—these were the most bitter.

The strange part of this is not that the newspapers were ready to print such attacks; there is a reason why some are hostile; the incredible part is that any of these charges should be taken seriously by the public. It is clear proof that Lindbergh is the least understood of famous men.

Before I was assigned as Colonel Lindbergh's aide on his good will tour of the United States I had a definite idea of him, gained wholly from newspaper stories and newsreels of him. In twenty-four hours after association with him I knew that idea was wrong, but it took a long time to correct it. Probably no one will ever completely know him.

I FOUND him modest, but not the painfully abashed type he had been pictured. It is half common sense, his seeing the folly of conceit. His attitude in planning the Paris flight shows how natural this modesty is. He had no idea of making himself famous. To him it was a great adventure one to be carefully planned, but still a glorious adventure that would take all his skill and courage. It did not occur to him that the world might go mad over him. He had even figured the cost of a "barnstorming" trip around Europe, never dreaming that public applause would last more than a day or two, at most.

I found the other half of his modesty was reserve especially about his feelings and his private affairs. And I found, as did others, that this reserve was backed by quiet determination that could become cold firmness on occasion. Unfortunately, occasions were numerous, for reporters were ordered to get "inside" that armor and they persisted in asking most personal questions, politicians sought to force him into projects they favored, and he was constantly subjected to a pressure that would have broken most men. But his iron will brought him through—as it took him to Paris.

Few people understand Lindbergh's refusal to talk of his sensations on the Paris flight. I used to wonder about this, and also his emotions during the four perilous times when he had to jump with parachutes in

(Continued on page 142)

"Mystery Fish" Outwit Scientists

Ten Thousand Men, Fleets of Vessels, and Millions in Equipment, and Yet the Salmon Keeps Its Secrets Hidden

By TOM WHITE

WHEN, some early morning next October, the *Star of Alaska* and the *Star of Holland*, old-time square-riggers both, sail through the Golden Gate and across San Francisco Bay, to unload their catch of tons of salmon at Alameda, Calif., many a weather-beaten seafaring man will view the sight with melancholy eyes. For it is said that the two great white-winged windjammers, last of their kind in the salmon trade and, for that matter, in any service on the Pacific Coast, are now on their final fishing cruise in Alaskan waters.

The unromantic but efficient steamer has superseded the stately square-rigger in the salmon fishing industry, and "Finis" will soon be written under one of the most colorful chapters in the history of America's shipping.

A valiant part in that closing chapter has been played by the Alaska Packers ships, or Star Fleet, of which only the two retiring veterans remain in active service. Once consisting of thirty of the finest sailing ships ever assembled under the American flag, it was known for years as the largest fleet of windjammers in the world.

ON THE Pacific Coast salmon fishing is a thriving modern industry. More than 10,000 men and a fleet of fifty ships of various types leave coast ports each spring for the northern seas, from which they return in the fall, loaded with "Alaska turkey." Every spring shipyards hum with activity. Steamers, motorships, and, up to the present year a few old windjammers, are made ready for their trip to Bristol Bay, a funnel-shaped arm of Bering Sea just north of Alaska Peninsula.

In the rivers emptying into Bristol Bay and in the waters just offshore are caught the red or "sockeye" salmon. These go to the canneries dotting the bay shore. Each company operates its own plant. The big factories with their expensive machinery are busy for only twenty-five or thirty days, during the run. During the remaining eleven months of the year they lie idle.

When the salmon ships drop anchor in Bristol Bay, they unload tons of tin plate and box shooks, or staves, for the canneries, where machines bend the plate into tin cans and fashion the shooks into cases to hold the "pack."

As soon as the last bundle of tin plate has been unloaded, the men "jump ship," eager to get ashore. They are no longer sailors; they are fishermen. From now on, for a month or five weeks, they are concerned exclusively with their gill nets.

Virtually all Alaska salmon are caught in nets. Of the many varieties, the Chinook king and the silver salmon are the only ones that will take the hook. The "king" is a true sovereign of the seas. He weighs from twenty-five to fifty pounds, and some of his royal family have been known to tip the scales at more than 100 pounds!

ACTUAL fishing operations along the Bristol Bay shores are carried on from small but staunch double-ended boats, each of which is handled by two men and sailed to the fishing grounds.

The "run" usually begins about June 25. The fisherman works close inshore. His net is leaded at the bottom, with cork floats fixed along the top. With the net all paid out, the boat is allowed to swing with the current or tide until the net forms a "bight" into which the salmon run.

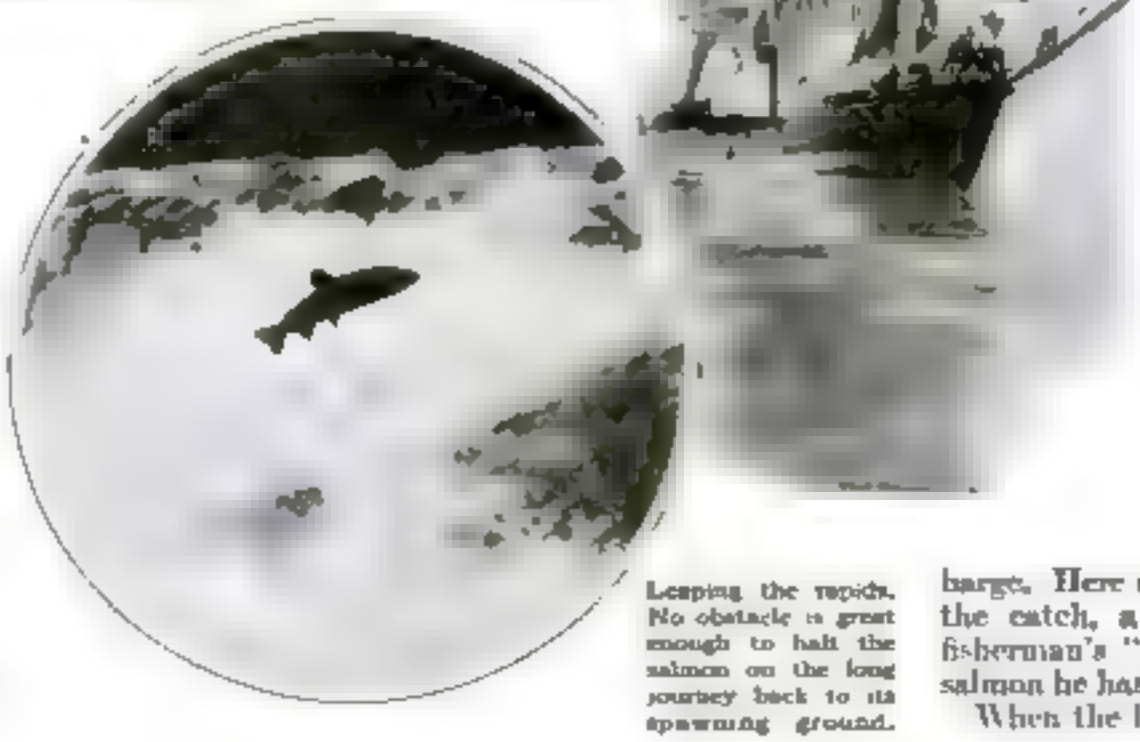
But the real job is hauling the net aboard! Sometimes the fishermen, in their zeal, fill their boats so full that their small craft are in danger of being swamped unless they cut away the net. This is promptly done, for fear of losing the fish already caught.

The boats have a capacity of about 2,000 fish each. As the salmon weigh from five to six pounds apiece, that makes a five-ton cargo, which often sends the boats' gunwales down perilously close to the water's edge! Once loaded, a boat is sailed to the nearest unloading scow or bank barge. Here an accurate count is kept of the catch, a tallyman entering in the fisherman's "pass book" the number of salmon he has delivered.

When the barges are loaded with from

Almost extinct.—Remnants of Star Fleet, once world's largest group of windjammers, at Alameda, Calif.

"Everything set and nothing drawing."—One reason why steamers are replacing sailing ships in salmon field.



Leaping the rapids. No obstacle is great enough to halt the salmon on the long journey back to its spawning ground.

100 to 150 tons, they are towed to the nearest cannery where the fish are thrown onto conveyors which carry them into the plant.

In all the operations great speed is necessary, for Government regulations provide that all fish must be canned or otherwise preserved before they are out of the water twenty-four hours. On the heaviest days of the run, when the canneries have more raw material than they can pack into tins, the surplus catch is quickly salted and pickled.

Conservation of Alaska's salmon supply is a problem in which our Government is actively concerned. Other strict regulations prescribe exactly what size nets may be used and the manner of handling them. The law also forbids the use of sweeps and drives by mechanical power, and regulates the actual fishing time. This last rule provides a closed period of from thirty-six to eighty hours a week, depending on the locality, to allow the passage of the fish upstream.

THE fisherman usually is paid a certain flat sum known as [illegible] amounting to $100 or $[illegible] for leaving to man his ship to and from the fishing grounds, and for discharging and loading cargo in the North. But the bulk of his earnings is based on the exact number of salmon he has turned in. The pay per fish ranges from four to eight cents and checks for the entire job will run from $800 to $1,200. In an exceptionally good season, a hard-working gill netter will have from $1,500 to $1,700 to show for his four or five months' absence from home.

More than 288,000,000 pounds or 144,000 tons, of salmon, equal to the weight of about 72,000 automobiles, are taken each year from Alaskan waters. The yearly catch piled [illegible] would form a mountain of approximately 4,000,000 cubic feet of fish, enough to fill the enormous gas bag of the dirigible *Graf Zeppelin*.

During the 1928 season 8,070,110 cases, each containing forty-eight pounds of salmon, were canned. The record pack was put up in 1918, when 6,677,308 cases—320,323,584 one-pound cans—were sent out of the North to feed a war-torn world.

Steam to the aid of sails. Tugs give a helping hand to the overdue salmon ship, *Star of Alaska*, coming to her anchorage in Chignik Bay, Alaska.

Hauling a loaded net aboard. In each boat the fishermen work in pairs, one handling the net, while the other maneuvers the boat with the oars.

MORE salmon are taken from the waters of Alaska than from any other part of the world. Behind this intensive industry lies a mystery which scientists have been trying to solve for years—the riddle of the strange spawning and migration habits of the salmon. The creatures sometimes swim thousands of miles, fight their way up torrential streams, often literally tearing themselves to pieces against the rocks, and starve themselves until they find their native spawning grounds, only to die there after reproducing themselves.

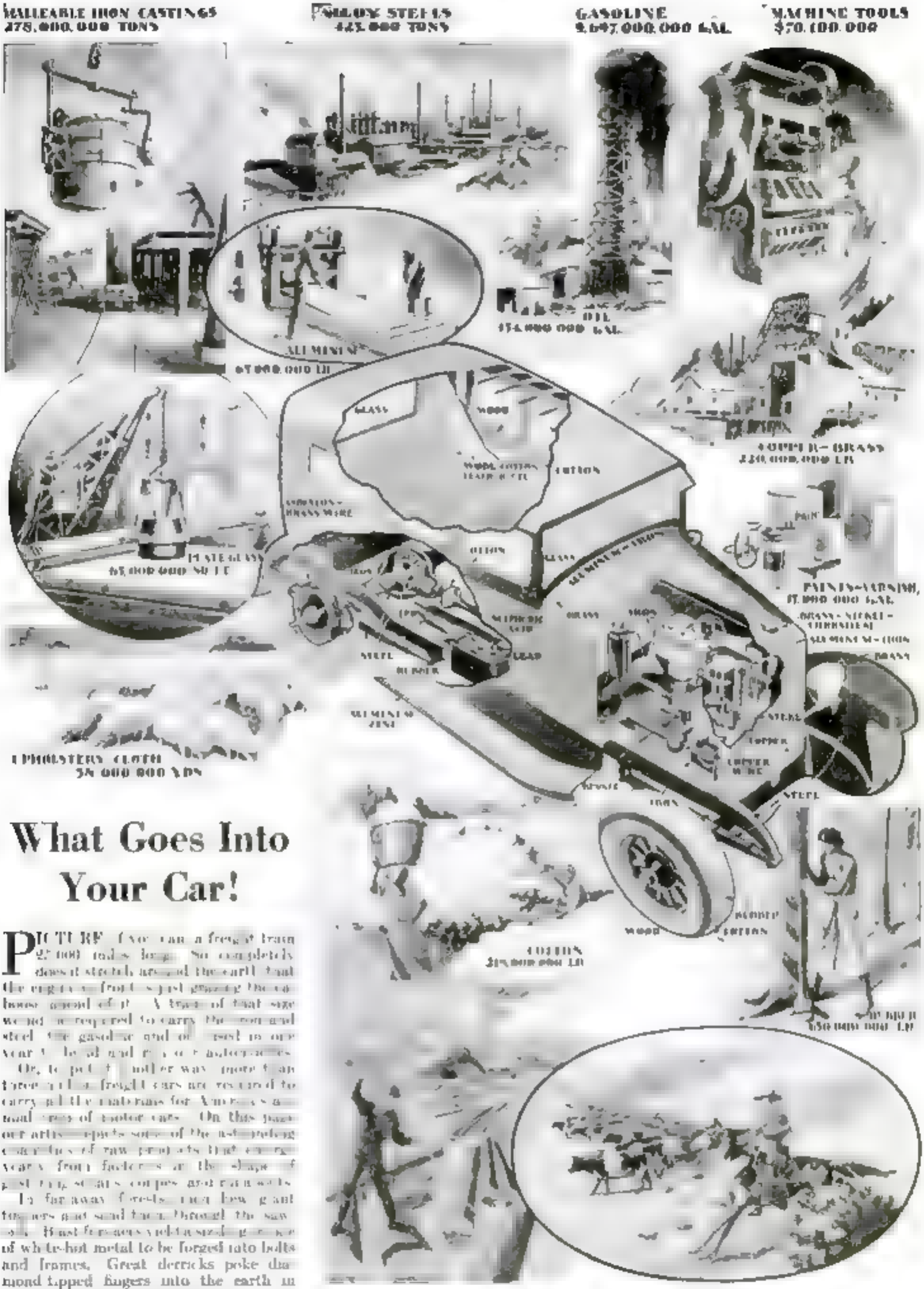
Every salmon, after about four years, returns from the open sea to a mountain lake or stream in the general region where it first saw the light of day. It is commonly believed that these fish, like birds of passage, "come home" to the exact spot. Do they? If so, how do the adults know when to come back? What instinct guides them along the uncharted ocean and river courses of their lengthy aquatic migrations? Nobody knows.

During the mid-summer spawning season, the salmon come in schools and shoals from the vast reaches of the Bering Sea, or the Pacific, or the Arctic. They throng the inland waters in their mad rush to get upstream, almost side by side, with barely fin-room between. Swimming tirelessly against the current of their native rivers, leaping up waterfalls and threading rock-strewn rapids, they reach the shallows after what frequently amounts to a thousand-mile journey. In the cases of the Columbia River in the United States, and the Fraser River, in British Columbia, it is a 3,000-mile swim. During this whole weary trek, sometimes lasting from May to October, the salmon do not take a particle of nourishment! As a result of this long fast, their digestive tracts shrink and cease to function. The young fish are hatched out about two months after the adults have spawned and died. They swim and feed together until they are from two to three inches long. Then they begin to work their way downstream and out to sea. Where?

TO SOLVE the salmon-migration mystery tagging experiments were carried on some years ago under the auspices of the United States Bureau of Fisheries by the late Dr. Charles H. Gilbert, one of America's leading ichthyologists, and Dr. Willis H. Rich. They trapped salmon in the open sea, tagged them with aluminum tags bearing serial numbers, and at the same time took samples of their scales. Microscopic examination of the scale samples revealed that certain scale developments are peculiar to definite localities. When the fish later were caught in fresh water and the tags were sent in to the investigators, together with information as to the stream where the salmon were found, they were able to show that salmon actually live in spawning colonies and return to the streams of their origin.

DR. GILBERT was convinced that salmon possess a homing instinct, similar to that of migratory birds. Other investigators doubt this and contend that the suitability of certain streams for hatching determines the course of salmon migrations.

But these mysteries little worry the busy fishermen. Their concern is that as large a number of fish as possible shall die not at the spawning grounds, but in the cannery.



What Goes Into Your Car!

PICTURE if you can a freight train 27,000 miles long. So completely does it encircle the earth that the engine at the front is just pulling the caboose around to it. A train of that size would be required to carry the iron and steel, the gasoline and oil, used in one year's motor car production.

Or, to put it another way, more than three million freight cars are required to carry all the materials for America's annual crop of motor cars. On this page our artist depicts some of the astounding quantities of raw products that emerge yearly from factories in the shape of cast iron, steel, engines and machines.

In far-away forests men hew giant trees and send them through the saw mills. Blast furnaces yield tremendous tonnages of white-hot metal to be forged into bolts and frames. Great derricks poke diamond tipped fingers into the earth in search of fuel to feed hungry motors. And all so that Americans may ride!

Photographs by D. Warren Sayer

Larry Brent (center) and his two Curtiss School instructors Randy Enslow (left) and Asaph Jordanoff.

Learn *to* Fly *with* Larry Brent

When the Ground Comes Swooping Up—That's When Your Heart Thumps! A Greenhorn Tells of His First Landings

By **LARRY BRENT**

RANDY ENSLOW and I were waiting for the motor of one of the blue training planes on the line to be warmed up. Enslow had appeared that morning without the mustache he had worn when I last saw him. I asked him why.

"To save weight flying with certain students," he grinned.

"Meaning me?" I inquired.

"Oh, you're not so bad," he replied. "Your air work is pretty good, except that you still pull your nose up on right turns. Your take-off is better. But your landings—did you ever hear the story about the instructor who threw the stick overboard?"

I looked at him suspiciously and said "No." Restless, impatient, quick in speech and action, Randy Enslow is a miser with words. He isn't given to telling pointless stories. I will never forget the four words which came popping through the speaking tube at me during an early lesson. I had the controls. Using only those four words, Enslow had me execute a left turn, then he had me increase the sharpness of the turn, then he had me pull the ship out of the turn, and then he gave me a full criticism of my entire performance.

The four words, coming like bullets and spaced a few seconds apart, were:

"Left! Tighter! Straighten!... Rotten!"

I was trying hard to please Enslow. I had corrected my earlier bad footwork. My touch on the stick was lighter and surer. And I was finally getting the feel of flying—becoming more and more a part of my ship. But I didn't like landings. Putting the nose of that ship down, cutting the motor, gliding into the field, feeling my controls suddenly get sloppy, pulling the stick at just the right second—it was nerve-racking.

I hated landings. I would either undershoot or overshoot the field. I would stretch out my glide—that is, with the motor cut and the ship gliding toward the landing, I would try with will power to float it to the desired spot. One of my stretched-out glides brought from Enslow this caustic comment:

"There are two wrong places to land a ship—fifty feet above the ground and fifty feet under the ground."

At that stage of my training, two out of three of the landings I tried were made, in the end, by Enslow. Several bad porpoise landings had destroyed my confidence. The man who has not taken flying lessons cannot realize how great the temptation is for the student to let his instructor pull him out of all difficulties.

"There was a student," Enslow began his story, "who didn't have any confidence when it came to landings. He was ground-shy. Every time he brought the ship down, he would let go the controls and his instructor would have to bring her in. He simply would not make landings.

It seems that that student was dumber even than the average student. Everything he learned had to be pounded into him. The instructor would say: 'Never mind why, but do everything I do, and do it just the way I do it.' And the student, in his dumb way, would try. But he wouldn't make landings. Always, at the last moment, he let everything go, and his instructor would have to bring her in.

"There are two wrong places to land a ship—fifty feet above the ground, and fifty feet under the ground," said Enslow caustically after my glide.

"AND finally the instructor got sore. One afternoon, in the pilots' room, he said to the gang: 'I'm going to make that kid get over his ground-shyness if I have to kill us both. The next time we go up, I'm going to pull the clevis pin out of my stick and throw the stick overboard. He'll either land that ship or get rattled and kill us. I'm going to take a chance

that it will cure him.' He was that kind of an instructor—hard-boiled.'

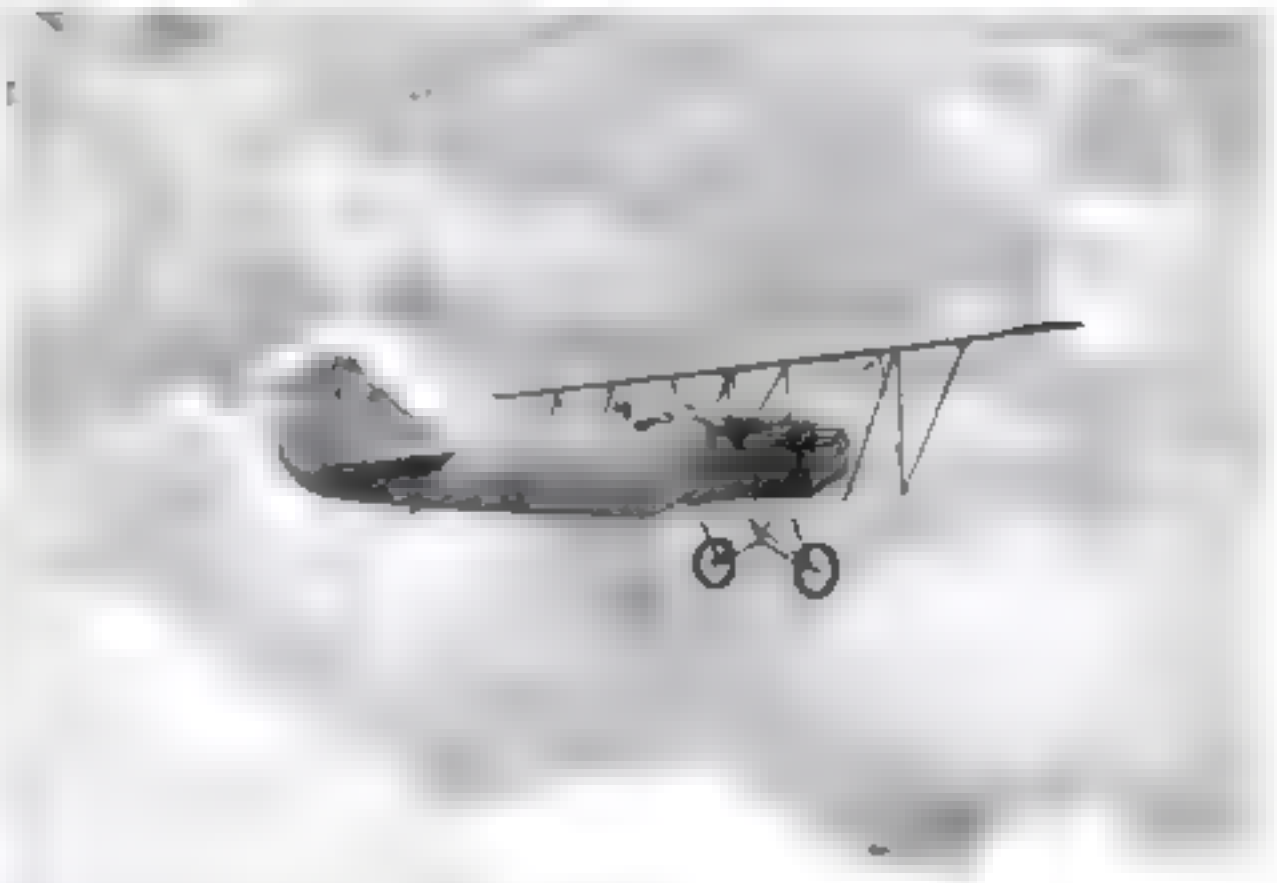
"Not soft and easy like you," I broke in.

"We'll take that up, later," said Enslow. "Well, on the next lesson, just as they were in the glide, the instructor took out the pin, pulled his stick out of the socket, held it up in the air for the kid to take a good look at and heaved it overboard. What do you suppose happened? Hadn't that kid been told to do everything his instructor did, just the way he did it? Without a moment's hesitation, the kid reached down, yanked out his stick, and heaved it after the other one.

"THE instructor almost fainted Neither of them had parachutes There they were, about five hundred feet up, in a plane without control sticks. Down, down they went in a glide—right into the middle of the field in the prettiest three-point landing you ever saw!

"When the instructor came out of his coma and looked around, the kid held up a stick. He wasn't so dumb, after all. He had been tipped off and had brought along a spare!"

I asked Randy Enslow if that story had a moral He gave me one of his vague looks and answered: "The moral of that story is that this morning I'm going to act as if there weren't any controls in my cockpit You're going to bring this ship down if it kills us After all, we're nothing but a pair of human lives."



"You're going to bring this ship down if it kills us Enslow had told me He sat in the forward cockpit with his hands clasped behind his neck.

Larry, watching a big cabin monoplane as it soars over Curtiss Field, dreams of the day when he too will be a full fledged pilot.

We climbed aboard and I taxied to the end of the field took off and flew toward the practice field, about ten miles away. Enslow, in the forward cockpit, sat with his hands clasped behind his neck. As we neared the field at about a thousand feet altitude, I made a wide turn and approached the landing into the wind. I conceived in my mind a straight line down the middle of the field. I was going to land along that imaginary line Maybe!

With my heart thumping and my stomach protesting as it always does when I'm in a tight corner, I cut the motor and nosed her down. I heard the wind whistling in the wires. I put the nose down a little lower The whistling went a note higher. I was going down too fast! I pulled the stick back a little to lengthen out my glide. The whistling went lower a note. It sounded about right now. That relieved my mind a little. I felt I was gliding at the proper angle.

DUCKING my head from side to side as the field loomed nearer, I can remember glancing at Enslow. With his hands behind his neck, he was looking up at an Army plane maneuvering above us He appeared dreamy and peaceful. He might have been sitting on a rocking chair on the front porch of his boarding house, instead of in a plane that was being brought to earth by a student in the clutches of ground fright.

The ground came swooping closer. My worries multiplied. Was it time to begin leveling off? Would I bounce? Would I pancake? Would I "wash-out" the plane?

Things finally looked about right. The ground seemed close enough So I gently pulled back the stick and leveled out. But the whistling in the wires did not die out as it should have.

UP CAME the earth to meet me, Crash! The wheels had struck. Up we bounced! We went so high on that bounce Enslow said afterward, that we could have spiraled down. That's what happens if you level off when you still have flying speed His left hand disappeared for a moment. He had slapped on the throttle. He jabbed a thumb at the sky. That meant climb.

I took her back up, feeling sick and sore and disgusted. Once again I circled the field. Once again I ran the gamut of emotions. This time I did not level off soon enough. I leveled off at four feet just after the whistling died out of the wires.

Down we pancaked! Crash! We rolled to a standstill. Enslow turned around and drawled.

"That will cost you four dollars for the fillings of my teeth. Try it again."

I tried it again. I tried it again and again. Sometimes I leveled off too soon, sometimes too late. Although it was a cold morning, my face was wet with perspiration. How easy it was to take off! How easy to handle a ship in the air! But how utterly impossible to make a good landing!

Every time I cut the motor at the top of the glide, my heart climbed into my mouth and my stomach shrank. Another sick moment is when the controls become

"The instructor pulled his stick out of the socket, held it up for the ground-shy kid to look at, and heaved it over the side."

logy—sloppy. It's all right for them to get that way the instant before you land. But there's no sensation more sickening than the feel of sloppy controls when you're too far up. Your ship no longer has flying speed. You're going to crash—pancake! If you mush many feet you may wash out your landing gear. You may spill over on a wing and wreck your ships. The seconds previous to touching ground are packed with the most awful tension I have ever experienced.

"I'll never learn to make a good landing," I said. "Yes, you will," said Randy. "It's in those last few seconds that you go wrong. Your glide is all right. All you need is confidence."

ENSLOW'S comment on the landings I made that morning was laconic. "Well, anyhow you tried."

I said: "I'll never learn to make a good landing."

"Yes, you will," said Randy. "Get busy again with the broomstick handle when you're sitting on the edge of your bed. Sit there and make landings. Get yourself into a state of mind where your judgment won't be rattled at the last minute. It's in those last few seconds that you make your mistakes. Your glide is all right. All you need is confidence."

I felt like asking him where more confidence was coming from. I had used up enough confidence for ten men that morning.

After seven bad landings, we called it a day. I wasn't ready to solo yet.

Immediately after this lesson, warm, rainy weather set in. The frozen ground thawed. Curtiss Field became a swamp. School flying was suspended. Only the hardiest of cross-country men went up. In one afternoon I saw two ships wrecked trying to take off. Both struck soft spots and went over on their noses.

IN BAD weather such as this, we devoted the entire day, instead of part of the afternoon and evening, to ground school. Ground school covers many subjects and covers them in great detail. These subjects include aviation terms, definitions, language, history, principles and theory of flight, practical flying instruction and rigging, engines, ignition, carburetion, instruments, aerology, navigation, meteorology, air traffic rules, air commerce regulations. In one day I have attended lectures on the history of engines, parachutes, adjustment of compasses, ignition, and valve grinding.

Ground school in many schools is now compulsory. The large schools are discouraging the student who wishes merely to fly without a proper understanding of why everything does what it does. The Curtiss Flying School recently ruled that no new student can begin flying instruction until he (or she) has put in at least two weeks in ground school.

Many of the small flying schools have no provision for ground school. Flying schools have sprung up so rapidly all over the country that it is impossible, unless a personal investigation is made, to distinguish a good school from a worthless school. The Aeronautical Chamber of Commerce, with headquarters in New York, is undertaking to give ratings to all flying schools. This organization has compiled a list of the requirements which schools desiring its recommendation must meet.

1. The minimum flying course to receive recognition qualifies a student for a private pilot's license.

2. All flying instructors must be licensed transport pilots.

3. All airplanes used in school instruction shall be licensed by the Department of Commerce.

4. A school, to be recognized, must give ground school courses in the subjects required by the Department of Commerce for a transport license.

5. Daily inspection of equipment must be enforced.

SPEAKING of flying schools recently Col. Lindbergh said: "The commercial flying school is one of the most important problems confronting aviation today. Most of our pilots in the past received at least a major portion of their training in military schools, but with the rapid advance in commercial flying the supply of these men is no longer adequate. Consequently it has become necessary to draw from pilots who have not had the opportunity of attending military schools, but who have received their instruction in commercial schools.

"These schools, in the past, have not been particularly well organized. In many instances the practice has been to advertise flying courses for their low cost rather than their high quality. It has been very difficult for a student to obtain enough instruction and solo flying experience to fit him for a pilot's position. Students are graduated from flying courses with ten hours or so in the air. These men cannot operate under federal licenses, but in a number of states they can carry on commercial flying with passengers, provided they do not cross the state boundary. Accidents due to improper training will continue to an excessive degree as long as federal inspectors have no control over intrastate flying activity."

In bad weather we devoted the entire day to ground school, which covers many subjects. (Larry is on rear bench.)

THERE is one stone wall I have run into—a wall that I cannot see any way of climbing over or getting around. How is the ambitious young fellow with all the necessary physical qualifications but with no money to become a commercial flyer? Some young fellows must be finding a way, because of the 19,000 applications for licenses received last year by the Department of Commerce, about sixty percent were from men

(Continued on page 156)

Someday We'll Look Like This

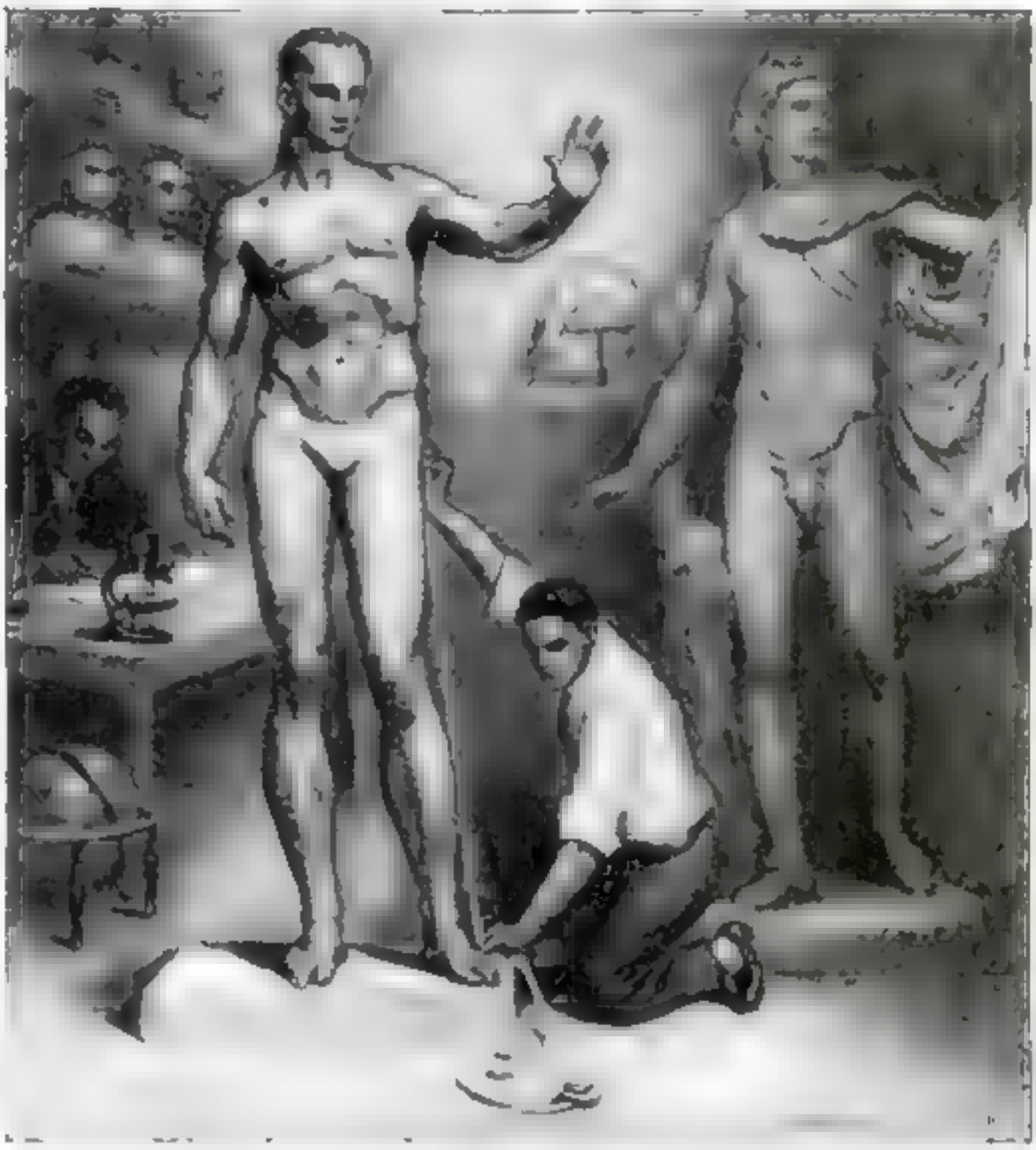
Future Man Will Be a Handsome Apollo with Long Legs and Short Arms, Dr. Ales Hrdlicka Predicts

By

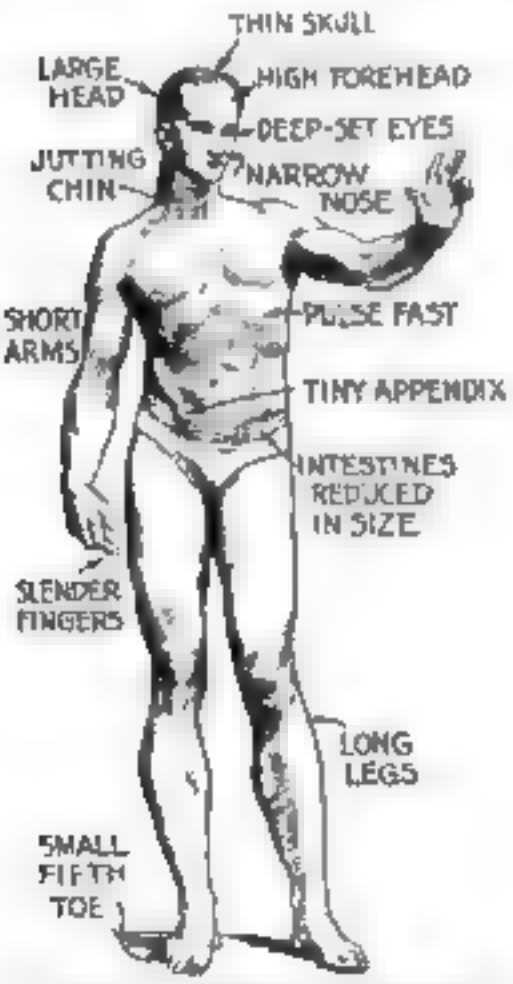
ARTHUR A. STUART

A MAN of commanding stature, short-armed but long-legged, will be the future inhabitant of the earth. His appendix and his fifth toe will have dwindled nearly to nothing, his forehead will be high and intelligent. He will be an Apollo for beauty.

These predictions are made by Dr. Ales Hrdlicka, curator of the division of physical anthropology at the National Museum, in Washington, D. C. Mankind he told the American Philosophical Society recently, is racing ahead as fast as ever in the process of evolution that began with man's birth some 500,000 years ago. And he challenged statements of some biologists that evolution has stopped as far as man is concerned. A few thousand years, he says, should alter the appearance of human beings considerably.



Our artist portrays here the man of the future, as predicted by Dr. Hrdlicka, and, for comparison, stands him beside the statue of Apollo Belvidere, long considered the ideal of physical perfection.



How future evolution may alter the structure and appearance of man's body.

Deep-set eyes, a prominent, narrow nose, and jutting chin will characterize the typical man of tomorrow, according to Dr. Hrdlicka. His skull will become thin largely because his jaw muscles, put less strenuously to work to eat refined foods, will exert less force. His face will reflect increasing handsomeness and character from this cause, as well as from intelligent breeding and increased brain size. His hair probably will be thin, for baldness will increase. The fate of his beard hangs in doubt. His body, slender in youth, will show the greatest outward change in length of limbs. Shortened arms and lengthened legs will terminate in narrow hands and feet. Fingers and toes will be slender; the fifth or "baby" toe in particular, will shrink. The future man will be taller, though not a giant.

Internally, important changes will occur. Highly digestible food, made possible by civilization, will reduce the size of the future man's intestines. His appendix will wane in size. His pulse rate will speed up as a result of more lively body activity.

Mentally he will be a superman, endowed with keen and sensitive intelligence. This will be only partly reflected in a bigger brain, for he will be smarter than that alone would indicate.

For all this, Dr. Hrdlicka believes, man must pay a price. He will live longer, but he will be ridden by disease. Bad digestion may trouble him, sleeplessness may make his nights hideous. Diabetes and skin troubles will probably increase, as well as insanity. Heart trouble and cancer will threaten him until they are mastered by medicine. Another danger appears in the low birth rate among people most advanced in intelligence, which may mean that society's lowest strata will have to provide the geniuses of the future.

PERHAPS by that time, however, we shall have learned to create geniuses and giants as they are required. Dr. Oscar Riddle, of the Carnegie Institution, Washington, D. C., has recently made the prediction that through gland extracts and laboratory methods of control, science may be able eventually to produce mental or physical supermen at will.

SPEED and Your Car

Lou Meyer, 24 years old, buyer who walked away with the 1st and 4th prize money

A cradle of the modern motor car—along the straightaway of the Indianapolis Speedway where the world's most daring speed kings match their nerve and skill. And so they give us better cars

By

ALDEN P. ARMAGNAC

HE'S out in front! Hurtling down the speedway comes a flying torpedo on wheels. A grim face behind the wheel is visible for a split second as it flashes by. A pack of roaring cars follow in hot pursuit. A checkered flag falls. He's won! Spectators roar tribute—thousands of them, from every corner of the world packed in the grand stand that borders the famous Indianapolis track.

A few days ago was run the annual red-letter event of motordom—the 500-mile Indianapolis race—deciding the speed laurels for another year in this classic. The battle of the speed demons, however, will be waged time and again on other tracks throughout the country, and other crowds will flock to see "the greatest sport on earth."

A sport with a purpose! It is not alone to give the crowds a thrill that daring pilots of two-mile-a-minute machines burnish the rims of saucer-shaped speedways. When the American Automobile Association sanctions these contests, it does so in the belief that the cars you and I drive for business and pleasure are the offspring of the brilliant-hued racers—little as they may outwardly resemble them.

Will the highways next year see cars that drive themselves by the front instead of the rear wheels? Will rocket cars speed you between distant cities? Will revolutionary new motors and fuels make over sedans and touring cars? It is on the speedway that these questions are answered.

Spinning around a saucer at 100 miles an hour—a strange way to learn to build a car! Yet ten years ago the average day's run of motor tourists was 180 miles. Last year, if you were a typical motor traveler, you covered 234 miles a day.

"This tremendous increase in mobility," declares Ernest L. Smith, general manager of the National Automobile Association, "is one of the most important factors in American life. The car that makes this possible is the direct descendant of cars used in high-speed tests.

Look at your car. What do you see? Balloon tires, a small multi-cylindered engine, a forced oiling system. These are not there by chance. They are among the survivors of countless other "improvements" that perished in the grueling grind of the race track. Mention any one of the refinements of your car, says Smith, and the chances are three to one that it was born of race track tests.

What a laboratory, where goggled figures in racing robes are the technicians! A driver slews around a corner, seems certain to turn over—rights himself and careens on. Another is not so lucky. They carry his limp form away. A flick of a wheel stands between life and death. Those who perish are, in a sense, martyrs to progress. And those who live can tell you hair-raising stories of swerves and skids, of fires that give them the choice of leaping from a car going 100 miles an hour or staying and trying to stop it before they are roasted. But few of the stories are stranger than that told by Ernie Easterberg, the driver who went on an involuntary flying trip in a racing car at Altoona, Pa.

Thundering around the saucer in a race over Atlantic City's mile and a half board speedway. Right: A fearful skid at the turn. The rear axle is seen giving way

HE WAS tearing into the last turn on a trial spin at more than 120 miles an hour. A gust of wind struck him. Then, in his own words,

Auto racing as it used to be. De Palma winning at old Sheepshead Bay N Y track

"Believe it or not, I flew through the air a hundred feet!" That most astonishing car just the way the air lifts an airplane's wings. I [illegible] have [illegible] with off the boards for I felt no jar when I came down that I was in the air all right!"

AS THE wind struck, my steering wheel had loosened in my hands. I twirled it a quarter turn, and it came round so easily I felt a shiver run up my spine. I looked down at the front wheels and I could see the tires move when I twisted the wheel." In a split second Vanderberg realized his danger. He was in the air. If those wheels weren't pointing straight ahead when he came down he would be killed. It was a delicate bit of steering, but he managed it.

Unquestionably the most spectacular race of motordom was the mile record, run at Daytona Beach, Fla., early this year in which the British driver Major H O. D Segrave, shattered all marks at the staggering speed of 231 miles an hour. Here is a race for thundering juggernauts built at a cost of thousands of dollars apiece to turn into one whizzing mile of speed the power of hundreds of horses stored in their mighty engines. Not everyone knows the colorful history back of this record, or how closely it is bound with the development of the modern car.

First of the racers in this thirty-one-year drama of speed, Chasseloup-Laubat, piloted a lumbering Jeantaud car over a course five eighths of a mile long. he [illegible] kilometer, which [illegible] mile race at an average clip of thirty-nine miles an hour! That record,

A racer in a spill at high speed. It's a thrilling game, in which the flick of a wheel stands between life and death

made in France in 1898, was regarded as terrifying speed. So rapidly did the science of automobile design advance however, that one year later Camille Jenatzy drove an electric car of his own make over the same course at sixty-six miles an hour. By 1903 the foreign record had reached eighty-four.

Here an American entered the contest, a man who had been known only to a few as the chief engineer of an electric illuminating company. He was Henry Ford. On January 4, 1903 this tall, lanky pioneer of the motor world doubled himself into what he called his "999" car and drove it a measured mile at more than ninety-one miles an hour. In the same year he founded what was to become the greatest automobile manufacturing company in the world.

America held the record now and the following year William K. Vanderbilt, New York sportsman, added another note of speed in his Mercedes car to make it ninety-two and a fraction. It was a short lived record; four foreign drivers held it successively, the same year, until in January, 1905, Arthur MacDonald brought it back to the United States with a 105-mile average. The very next day H. L. Bowden eclipsed this with a 110-mile record, starting a series of new marks that were not to be improved abroad until 1922.

A startling novelty appeared among the contenders lined up on January 26, 1906—a steam car, piloted by Frank Merriott. Many were the jibes cast, while the ponderous boiler was being filled with water for the race. A few minutes later it tore down the course to hang up a 127-mile-an-hour record! That record was good enough to withstand all assaults for four years. For a time it looked as if the steam car was destined to be the automobile of the future. Many of us can remember pygmy "steamers" that actually did appear on the highways. But they were ruled out in the final verdict of the Supreme Court of the Speedway.

In March 1909, Barney Oldfield sped to a 136-mile mark—one of the first of the triumphs that made his name synonymous with auto racing up to a few years ago. Today, having retired from auto racing, he is one of the organizers of a new U. S.-to-Mexico air line. His record passed the following year to Bob Burman who, like Oldfield, drove a Benz car but, this time, at 141 miles an hour. In 1919 Ralph De Palma attained a speed a fraction of a mile short of 150 miles an hour.

TOMMY MILTON smashed every record at Daytona Beach, Florida, in 1920, by covering the mile course at 156 miles an hour. In 1922 the record passed to Britain and since then has been held almost continuously by a trio of Englishmen: J. G. Parry-Thomas, Capt. Malcolm Campbell and Major H. O. D. Segrave. For the first time appeared super-speed cars such as had never been seen before, of weird and unconventional design. On Pendine Sands, Wales, Parry-Thomas attained 170 miles an hour in April 1926. Attempting to raise his own record in March, 1927, he met instant death when a drive chain broke and slashed his rear tire to pieces, just as he was speeding onto the course at 180 miles an hour.

To date the mile record has been the basis of a friendly duel between Campbell and Segrave, with timeout while Ray Keech, American driver, held the honor last year with the 1,500-horsepower Triplex car built by J. M. White, Philadelphia sportsman. This car, devoid of streamlining, relied solely upon brute power and Keech's powerful physique at the wheel. In the hands of (Continued on page 144)

White Rocket, America's first rocket car in tests at Santa Monica, Calif. Lee Moore, noted race driver is at the wheel. Left: *Black Hawk Special* turning the somersault that killed Lockhart at Daytona Beach.

Back of the Month's News

A magnificent view of the Jathraya of Gibraltar from high in the great rock fortress. In straight cliff above the new tramway all beneath and behind is sheer drop of the face to the beach

British troops drilling on parade grounds at the foot of the Rock of Gibraltar. Huge reservoirs hollowed in the 1,400 foot limestone cliff supply plenty of drinking water.

Workmen drawing water from Gibraltar's 10,000,000 gallon reservoir to supply the town and garrison at the fortress. It is distributed in pipes to various parts of the huge rock

By KARL VOOGHT

WATERSHEDS with a total area of thirty acres recently began diverting rain into great reservoirs hollowed out within the Rock of Gibraltar. Into these man-made subterranean lakes, a single inch of rainfall will pour almost a million-gallon reserve.

This new system of storing drinking water for the garrison and for the city at this natural fortress at the western entrance of the Mediterranean culminates a long struggle to obtain ample water supply. There are no springs on Gibraltar. For more than two centuries the British, who have occupied the rock with its precipitous, siege-resisting cliffs, have sought means of storing water for a time of need. Underground tanks were found to be the only successful method of keeping the rain water fresh. These were the forerunners of the huge 10,000,000-gallon reservoir of the present system.

[illegible] tests of sea water stirs [illegible] to produce it. But [illegible] water [illegible] stations of the type [illegible] drawing all their water instead of [illegible] tanks. Vapors [illegible] condensing drinking water [illegible] [illegible] water problem [illegible] parts of the world.

[illegible] wonder why you get thirsty so often [illegible] that two thirds of your body is water. If a 150-pound man were completely dried out he would weigh no more than the average seven-year-old boy! Your muscles contain half the water in your body, and even your "solid" bones are fifty percent fluid.

No wonder, then, that pioneers the world over have built their homes near springs and that modern cities spend fabulous sums to insure abundant drinking water. Even ancient civilizations kept slaves busy constructing waterworks. Eleven thousand men once worked two years cutting a tunnel to form part of Rome's elaborate system of aqueducts. With modern machinery and explosives, a hundred men could accomplish the same task in ten months.

THIRTY years after the Pilgrim Fathers landed at Plymouth Rock, the first water system in an American community was constructed. Pipes of wood conveyed the fluid from a spring to a tank, from which it was drawn by the neighboring householders. That was the forerunner of the great aqueducts of New York and Los Angeles of today. The former supplies nearly a billion gallons a day and the latter crosses a desert to tap a pure mountain supply.

The Lamps of the Future?

THAT "artificial fireflies," lamps using the same mysterious compound that gives the firefly its blinking light, may illuminate tomorrow's homes is the recent startling suggestion of Dr. E. Newton Harvey, professor of physiology at Princeton University.

Scientists have long envied the firefly and other glowing creatures their cool, effective illumination—apparently 100 percent efficient. None of their energy is wasted in heat, it all goes to make light, by a chemical process now well on its way toward being understood.

Tens of thousands of species of animals, it is estimated, are luminescent. Even the eggs of some animals shine in the dark. The glow of damp wood, known as "fox fire," is due to luminous fungi, while certain bacteria themselves luminous, produce the phosphorescence of dead meat or fish, sometimes observed in the refrigerator.

Queerest of all the [illegible] creatures,

perhaps, is the "automobile bug," a South American insect that is reported to have white lights at its head and red ones at its tail. Two kinds of luminous fish in the Dutch East Indies owe their beacons to bacteria that glow. A large organ just beneath each of the fish's eyes is designed by Nature as a hotel for these bacteria, which receive free board and lodging in return for the light they supply. Another curiosity is an Italian squid that ejects a luminous secretion when alarmed, surrounding itself in a "cloud of fire" while it escapes from its enemies.

SO FAR, "living light" has at least one practical use. Natives of the West Indies and South America use tropical fireflies for bait in fishing, as well as for personal adornment. Until recently, however the nature of this light has remained a mystery. Now chemists have succeeded in analyzing the materials by which luminous animals glow—and predict that we may be able to manufacture them ourselves! The "living light," they say, is made of two parts—one called luciferin, that glows when it comes in contact with the air's oxygen, and the other, called luciferase, that regurities the used-up luciferin and fits it for service again.

"Chemically," Dr. Harvey declares, "luciferin is probably to be placed among the simplest of proteins, and we already can manufacture certain simple proteins in the laboratory. Personally I think the time will come when we shall be able to make artificial luciferin." Luciferase might be made as well, it is recognized as related to the albumins.

Dr. Harvey paints a fascinating picture of future illumination. Huge lamps might burn firefly oil over and over again, producing heatless light without waste. Ceilings, painted with the luminescent material, might shine after dark. Their light regulated perhaps by dark curtains.

Lake Gives Up Roman Galley

FROM the waters of Lake Nemi, in the crater of an extinct volcano twenty miles from Rome, Italy, the rotting prow of a sunken galley, 2,000 years old, recently came into view. It is the first of two ancient Roman vessels known to lie half-buried in the mud at the bottom. Powerful electric pumps, lowering the surface of the lake at the rate of an inch a day, diverted the water through an old Roman conduit down the mountain and made the salvaging possible.

A study of these boats, built in the time of Christ by the mad Emperor Caligula, and the objects they are expected to contain, may reveal fascinating new facts about the people and customs of nearly twenty centuries ago. Their recovery, as the first 1,000-foot liner is under construction, emphasizes the enormous progress in shipbuilding since the days of Rome.

The world's first boat probably was a log straddled by a Stone Age man. Then came rafts of logs lashed with vines, or strips of skin. When Pizarro, Spanish conqueror of Peru, sailed down the South American coast, he met natives navigating elaborate rafts of lighter-than-cork balsa wood far out at sea. Sails propelled them and sheds, erected on board, protected the voyagers.

By hollowing out a log, with fire or primitive tools, the early Lake Dwellers of Switzerland improved on the raft. The bogs of Ireland have yielded remains of similar boats. Twenty feet of earth covering them attest to their great age.

Long rows of oars, in banks one above the other, drove the war galleys of Mediterranean countries from the time of the early Pharaohs of Egypt to the Moors of the seventeenth century. The top bank often had oars fifty feet long, with seven rowers, mostly slaves or war prisoners.

In the north, the Vikings with their dragon boats, each driven by a hundred hardened oarsmen, swept the seas. They are believed to have reached the North American Continent by way of Iceland.

When sails supplanted oars, Columbus and Magellan opened up unknown worlds. The discoverer of America crossed the Atlantic in a little ship 128 feet long. A string of half a dozen *Santa Marias* could hide behind one modern liner!

THE man who first proposed steam to propel vessels was put in an insane asylum as a result! He was Salomon de Caus, confined as a madman in the seventeenth century by the French government. The *Clermont* of Robert Fulton vindicated De Caus in 1807, and American shipbuilders began preparation to conquer the Atlantic with steam. When the side-wheeler *Savannah* anorted into a British port after the first ocean crossing, a learned speaker had just finished reading a paper that proved that no vessel could carry sufficient coal to drive it across the ocean!

The screw propeller soon replaced paddle wheels (first used by the early Chinese) and side-wheelers disappeared from ocean traffic. Iron replaced wood in big ships. Then came steel, making possible today's *Leviathans* and *Ilyitanias*, floating cities [illegible] than the height of the tallest skyscraper and able to plow through the water faster than the speediest sprinter can run a hundred yards!

Oil, electricity, powdered coal, to run the engines, the gyroscope, to preserve balance, the radio compass, for finding direction and location in fog—these are [illegible] the most recent steps in the advance from the log to the super-liner.

Why You Lose Five Pounds in the Summer

DR. EUGENE LYMAN FISK medical examiner for the Life Extension Institute, New York City, declares that New Yorkers weigh 8,000 tons less in summer than in winter. More than eight freight trains of average size would be required to carry this weight which disappears with the coming of summer.

The average man, Dr. Fisk says, loses five or six pounds during hot months.

Physiologically, we decrease in weight every time we exhale a breath, giving off some of the moisture of the body. But summer sweating is not due to evaporation of the weight lost through perspiration is largely regained in the drinks we consume. The loss is partly due to reduced diet, although a single ice cream soda is said to contain as many calories as a meal of fish cakes, bread and butter, and macaroni. Most of the loss in weight may be ascribed to greater activity that expends our food fuel in energy instead of storing it up in fat.

Like coal, normal fat represents a reserve of potential energy. The hibernating bear, sleek when it disappeared in the fall, is emaciated in the spring. The surplus weight was burned up

Light [illegible] aids [illegible] has [illegible] the lake [illegible] expose [illegible] sunken Roman galley [illegible]

Powerful electric shore pump used in draining Lake Nemi in salvaging Caligula's galleys. The picture in the circle shows the prow tip of one of the ancient vessels barely out of water. The surface of the lake needed to be lowered less than three feet more to expose the stern of the vessel. The sunken galleys have rested on the lake for nearly two thousand years.

in producing energy consumed in operating the heart and lungs while the animal slept.

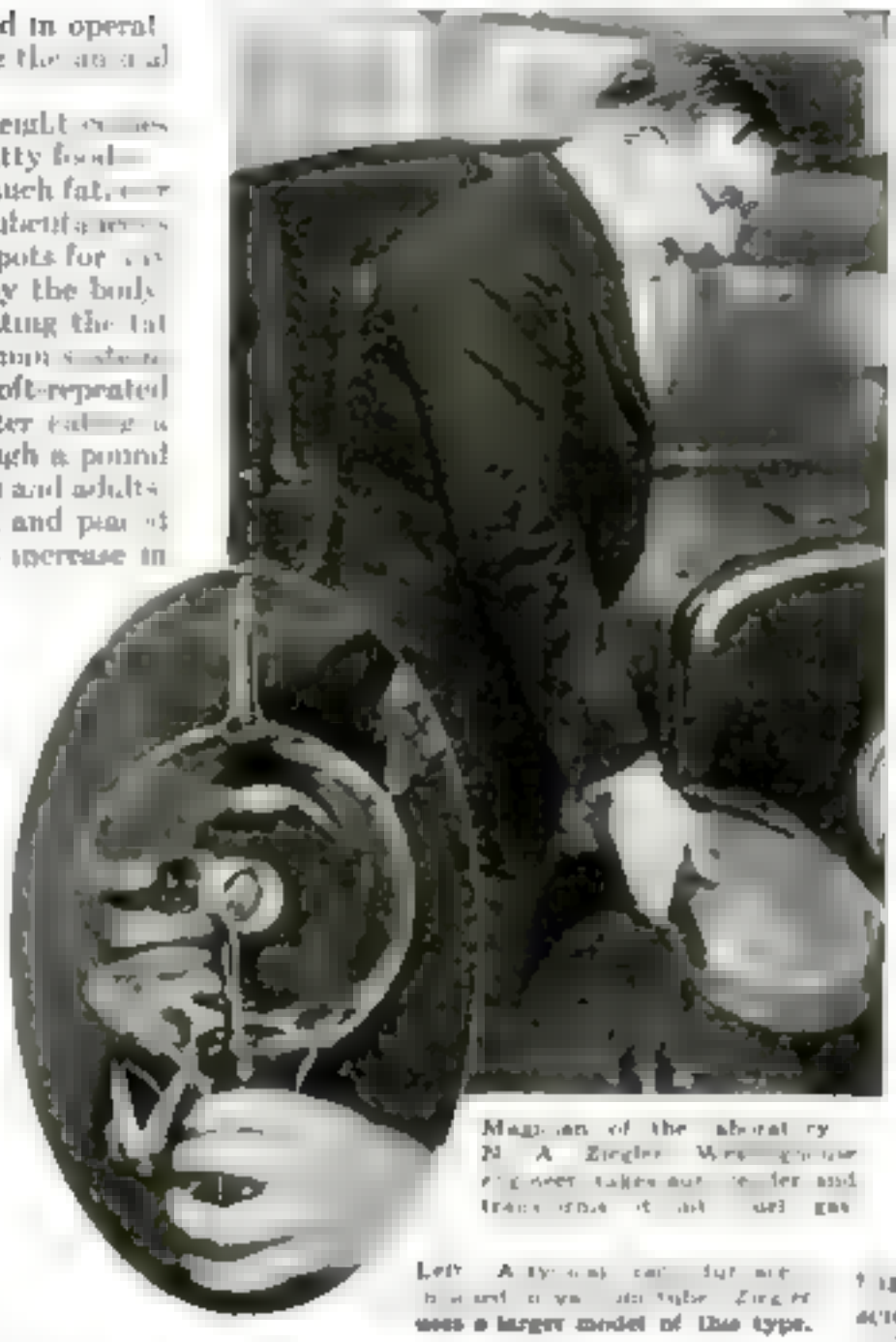
In human beings, excess weight comes almost entirely from eating fatty foods.

Immediately after eating much fat, the blood carries it to the subcutaneous tissues that act as storage depots for the surplus not needed at once by the body. While the process of assimilating the fat begins immediately in the human system, science has disproved the oft-repeated statement, "if you weigh after eating a pound of food, you won't weigh a pound more." In actual tests, babies and adults fed known quantities of food and put upon the scales, showed an increase in weight exactly equal to that of the food eaten.

Fuel Gas from Scrap Iron

GAS from old automobile fenders and cast-off stove lids is the latest novelty, made possible by melting metals with powerful electric currents in a glass-walled vacuum furnace. When N. A. Ziegler, of the Westinghouse Research Laboratories, subjects iron to this treatment, it gives up thirty-three times its own volume in a combustible gas that will run automobiles and cookstoves.

The Ziegler process as yet is more of a laboratory curiosity than a practical commercial scheme. But there are other unusual and practicable ways of obtaining gas, besides the standard methods of piping it from wells or manufacturing it from coal.



Magician of the laboratory: N. A. Ziegler, Westinghouse engineer, takes out cylinder and tests gas that has been made from iron

Left: A typical cast-iron stove lid and crystalline iron. Ziegler uses a larger model of this type.

Oil decomposed under terrific heat and pressure in iron retorts, supplies the "Blau gas" fuel used to drive the motors of Germany's great dirigible, the *Graf Zeppelin*. Other fuel gases, notably those for household use, are made from such varied sources as wood, gasoline, oil, and liquefied natural gas, and are supplied in tanks to consumers.

One recent novelty in gas manufacture is a portable device for inflating small pilot balloons used in weather observations. The apparatus resembles a portable fire extinguisher and generates more than twenty-five cubic feet of hydrogen gas at a single charging by the action of caustic soda upon the chemical powder, ferrosilicon. It is used also to inflate children's balloons in quantity.

Such methods depend upon chemical reactions, but it remained for Ziegler to discover an electrical gas-making process. While searching for better magnet metal, he heated scraps of cast iron and steel in a curious type of electric furnace that induces powerful electric currents in the metal by subjecting it to high-frequency waves like those of radio. Such a "radio furnace" melts the hardest steel but will not scorch paper. When the current is turned on, its glass walls glow with a brilliant blue light.

When Ziegler placed iron in the furnace, in a vacuum, it became incandescent and melted. A gas that had apparently been inclosed in the metal bubbled off. When removed from the vacuum it burned with a pale blue flame. Two cubic feet of cast iron gave gas enough to generate twelve horsepower for about twelve minutes.

Queer Symbols Speak a Precise Language

APPROVAL of a select list of forty-three types of symbols to express mathematical ideas recently marked the first step of the American Engineering Standards Committee to clarify still further the already highly explicit language of science. Though many of the symbols recommended for universal use seem queer to the layman's eye, each has a certain exact meaning that is typical of the care with which science picks its phrases.

At first glance it may seem cold to burden the violet that blooms in the spring by the ponderous name of *Viola cucullata*, the common little blue butterfly, familiar to every schoolboy, with *Lycaena pseudargiolus*, or to term a certain organic chemical, *homopiperonyldimethoxydihydroisoquinoline*. Nevertheless, there is a good reason.

The seventeen-year locust goes under the name *Cicada septendecim* when he is in scientific company, revealing the fact that he is not a locust at all, but a true cicada. To a layman, a mosquito may just be a mosquito, but an *Anopheles* can give you malaria, a *Stegomyia* carries yellow fever, while a *Culex*, for all its annoying bites, does no more harm than to produce a slight swelling.

A yellow chemical called "prussiate of potash" is harmless, another "prussiate of potash," red in color, is a deadly poison. In popular language distinguished from the first only by its color. The first science knows as potassium *ferro*cyanide, the second as potassium *ferri*cyanide, and to make no mistake it writes their formulas $K_4Fe(CN)_6$ and $K_3Fe(CN)_6$. The more the terminology of scientific men is examined, the more apparent it becomes that it is based upon common sense.

Improving Phone Cables

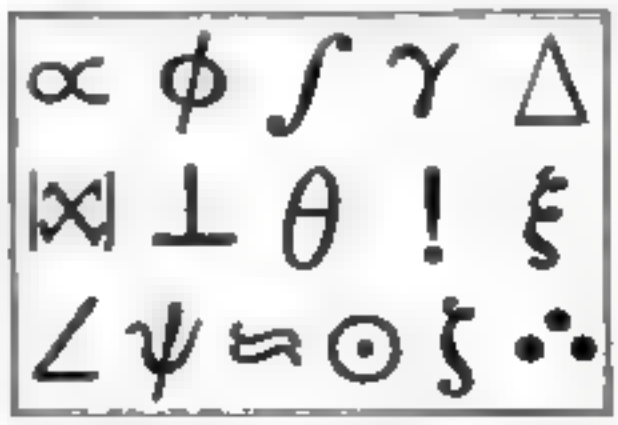
PHYSICISTS of Cornell University, Ithaca, N. Y., have discovered that electrons, the minute electrical units of matter, cause the deterioration in the high-tension lead-sheathed cables that carry electric power beneath city streets.

The investigation showed that cables grow hot in use, and the lead sheath

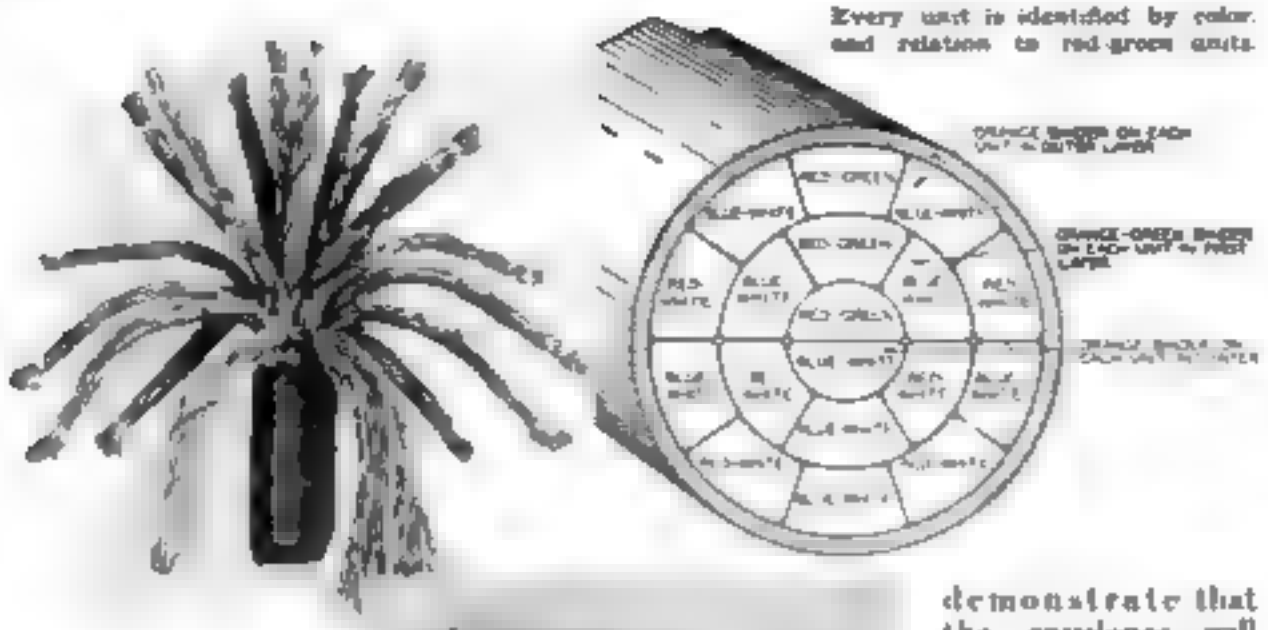
How Much Do You Know About Firearms?

TEST your knowledge with these questions, chosen from hundreds asked by our readers. You will find the correct answers on page 141.

1. When you shoot a revolver, the barrel jumps upward. How do you aim to compensate for the jump?
2. Why does a gun shooting smokeless powder kick less than with black powder?
3. Did old-time cowboys and sheriffs shoot as accurately as reported?
4. Why doesn't a rifle kick back as hard as the bullet strikes the game?
5. What pressure is developed inside a rifle barrel?
6. Why do some states prohibit high power rifles to shoot big game?
7. How does an automatic pistol work?
8. How do you figure out how far ahead of a duck to aim so you will hit him?
9. Is a shotgun full choke bored if you can drop a dime through the muzzle?
10. How fast does a bullet have to go so it won't drop?



No, this is not a secret message in some strange code simply a few of the mathematical symbols which the American Engineering Standards Committee has just approved. Each has a very real and definite meaning.



A curious new plant? Not exactly. It's the separated end of the newest telephone cable. The eighteen "stalks" are units each containing 101 pairs of wires.

Cross section of the 1,818-pair 16-gage cable, showing arrangement of units. These units are untwisted, and then covered by lead sheathing.

expands. But the lead does not contract when the cable upon cooling, resumes its normal size. The voids in the insulation, formed in this way, contain gas at low pressure. This creates a favorable condition for ionization—the formation of ions and electrons. The electrons bombard the insulation in the cable until it deteriorates. The Cornell investigators are seeking an oil or some other compound that will resist the electronic onslaught.

The construction of electric cables is being improved constantly. The Bell Telephone Company recently placed in service a cable containing the largest number of wires ever carried under one sheath. It is a 1,818-pair cable, consisting of exactly 3,636 separate wires! This was made possible, first, by the small diameter of the wire, half of that of an ordinary pin. Secondly, a new way of arranging the wires in the cable was devised—the "multiple unit" arrangement. Previously cables were formed by spiraling layers of wire until the full size was reached. The new cable consists of eighteen different groups of wires, or units, each comprising 101 pairs. These are twisted together, after which the cable is completed by the usual lead sheathing. The third factor in making the new cable practicable was the development of a thinner paper for insulation, which takes up considerably less room without losing its effectiveness. Machines wrap the paper around each wire at high speed.

Why Stamps Come Off

THE sticking quality of postage stamps has just been tested in a series of experiments by the U. S. Bureau of Standards, Washington, D. C. The results indicate that it is not cold nor heat, but dry air, that affects their adhesiveness. In one test, letters were tossed back and forth in a revolving drum to demonstrate that the envelopes will wear out before stamps, properly applied, come off.

It is not generally known that a blind man gave the world its postage stamps. In 1840, Sir Rowland Hill, head of Great Britain's postal service, suggested the idea which has since spread to all parts of the globe. The first American stamps appeared in 1847 and bore the portrait of Benjamin Franklin.

You could cover more than 2,000 acres with the 10,000,000,000 postage stamps produced in the United States in 1927, the last year for which statistics are available. Only a few were defective.

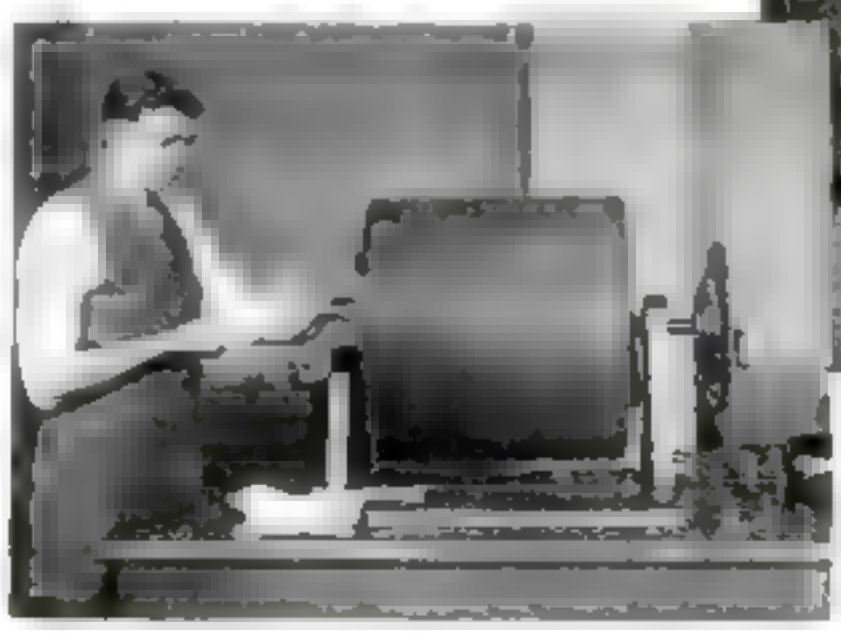
Electricity from Heat

AN AMAZING magnet that can lift a 145-pound man with ease was demonstrated recently in New York City. It works by electricity—but there are no electric wires attached to it. Instead, the flame of an acetylene burner, licking a copper fin that projects from the magnet's side, provides the electric current. Here is realized on a laboratory scale a dream of inventors—electricity direct from heat, without the intervention of boilers or dynamos.

The German physicist, J. T. Seebeck, discovered in 1821 that if he joined two wires made of different metals, heated one junction, and cooled the other, a feeble electric current would flow around the wires. Antimony and bismuth worked best of all the metals. The explanation of this effect, termed thermoelectricity, now accepted, is that identical volumes of two different metals enclose different numbers of free or current-carrying electrons. When heat "stirs up" the electrons, the excess of them on one metal flows to the other, setting up an electric current.

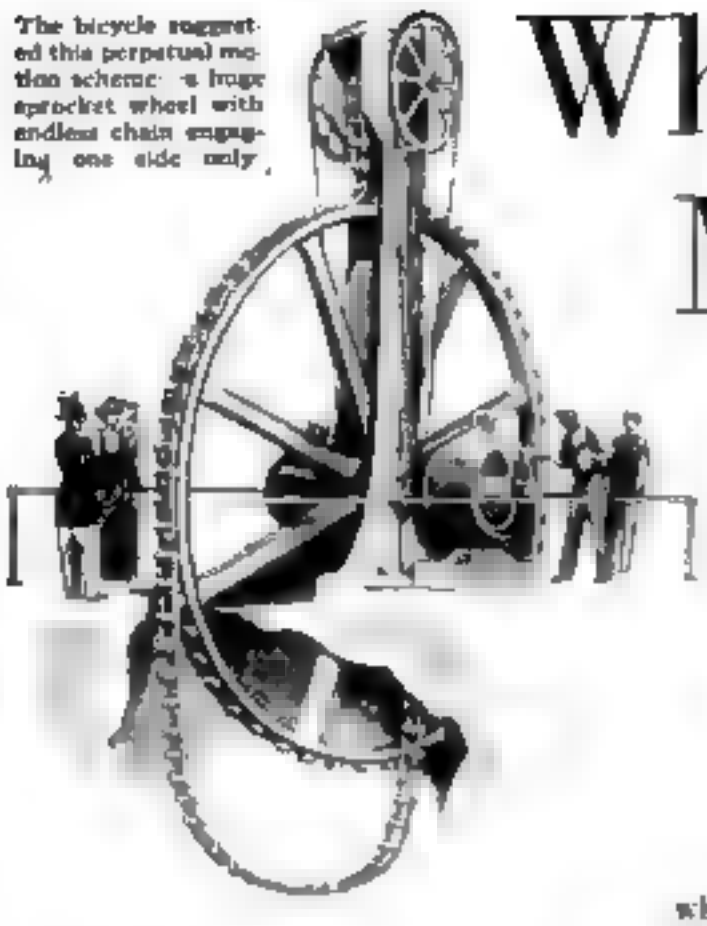
WHILE commercial power from heat electricity is still a dream, electricity from heat serves us today in other ways. A fused joint or "thermocouple" of two metals—usually platinum and a platinum-rhodium alloy—measures a furnace's heat in commercial pyrometers, which are simply high temperature thermometers. More sensitive thermocouples, placed at the focus of a curved mirror, can detect the heat of a candle six miles away! Astronomers use them to study star temperatures. Some they respond also to cold, ships could detect distant icebergs with them.

Perhaps the nearest approach to power on a practical scale is the startling demonstration in New York of the new heat magnet, designed by Dr. Paul E. Klopsteg. In its iron magnet core is embedded a single current-carrying loop of copper, closed outside the magnet by a bar of copper-nickel alloy. From the joints project two copper fins, one immersed in a jar of cooling water and the other heated by a flame. A current of tiny voltage but tremendous volume, about 135 amperes, is believed to flow through the loop. This is enough to allow the heat-electricity magnet to hold as much weight as 200 pounds.



A 145-pound man suspended by the strong [illegible] the new heat-to-electricity magnet, in which water cooling and heating by the flame of an acetylene torch [illegible]

In receiving from the U. S. Bureau of Standards letters are tossed about [illegible] other stamps



The bicycle suggested this perpetual motion scheme: a huge sprocket wheel with endless chain engaging one side only.

Why *IS* Perpetual Motion Impossible?

TUCKED away in the heads of most of us is a thought that perhaps someday, somehow, a great genius may produce a workable perpetual motion machine. Yet to every inventor who submits such an idea the U. S. Patent Office sends a form letter, part of which says: "All such attempts must be utter failures, as it is always impossible to obtain more power out of any machine than is originally put into it." Why? This article answers the question.

By EDWIN W. TEALE

LAST year dozens of people tried to patent perpetual motion machines in the United States. Many of the plans were even accompanied by devices optimistically labeled "Working Model." And so confident were some of the applicants that they included brakes in their machines to restrain them from running too fast!

The Patent Office says frankly that perpetual motion is impossible. Does this discourage the inventors? Not so you can notice it in the records of patent applications. Year after year, hardly a week has gone by without the mailman leaving another perpetual motion machine on Uncle Sam's doorstep. And not one has ever worked.

The record of man's search for this mechanical will-o-the-wisp began during the Middle Ages. One of the earliest attempts to build a machine that would run by itself forever was made, soon after A. D. 1250, by a French architect, Villard de Honecort. His idea was to attach an uneven number of weights around the rim of a wheel by hinged arms, which would allow those on one side to swing inward toward the rim and those on the other to swing outward. The added leverage on the side with the weights out would pull the wheel downward on that side and start it moving. As the weights would continue to swing inward on the rising side and outward on the descending side, the wheel, he thought, would keep turning until it wore out. And he was mystified when it failed to work.

In the fifteenth century, Leonardo da Vinci, the Italian painter, devised a similar wheel. A single trial convinced him, he wrote, that the search for perpetual motion was the search for a chimera.

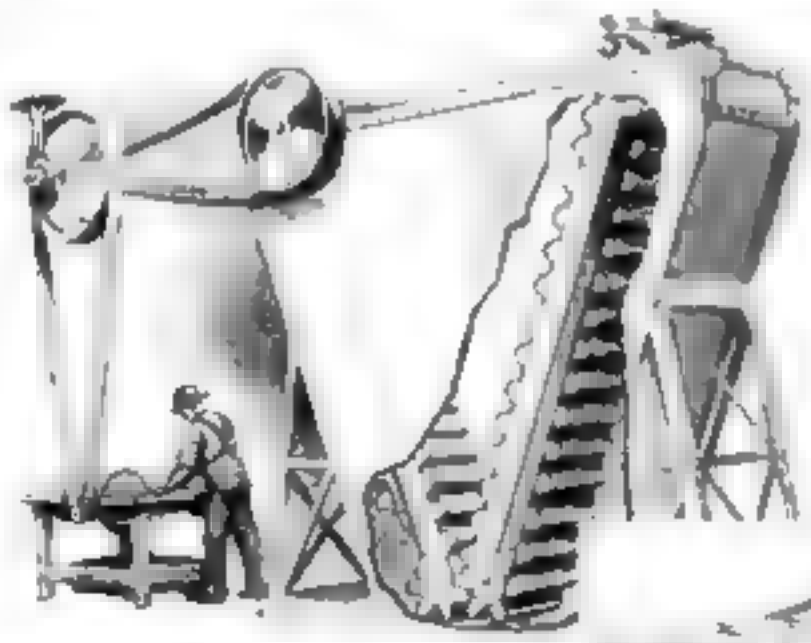
The same idea of obtaining endless power from an overbalancing wheel bobbed up again in England in 1640. The Marquis of Worcester announced a wheel "that would turn forever," driven by swinging weights on the rim. He demonstrated it in the Tower of London before King Charles I and most of his court. History does not record the verdict, but the invention immediately sank into oblivion, indicating that the trial was a dismal failure.

When the first patent for a perpetual motion machine was granted in England on March 9, 1635, the plan submitted was for an overbalancing wheel. Again in 1770, "The Peasant Boy Philosopher" Sir James Ferguson, a Fellow of the Royal Society, embodied the idea in an intricate mechanism with jointed spokes, heavy balls, and shifting weights. His purpose, however, was to demonstrate that obtaining power from such a wheel was impossible. Nevertheless, of 606 patents granted in England for perpetual motion machines up to the beginning of the present century, a large share were based upon this very plan.

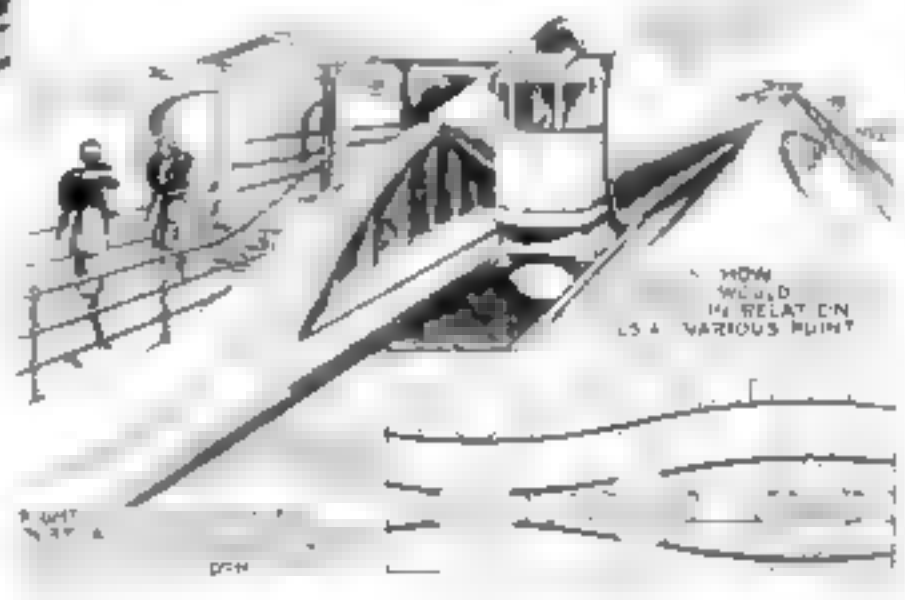
When the bicycle came into vogue, it suggested an attempt to get something for nothing by the use of a huge sprocket wheel and a heavy endless chain. The chain engaged the teeth on one side of the sprocket, falling away at the bottom and being lifted straight up to be fed back on the sprocket at the top. The inventor figured that leverage of the weight of the chain on the sprocket teeth on one side of the wheel would be sufficient to turn and lift the free half of the chain back to the top. In actual practice, the effect was the same as hanging a bicycle chain over a pulley. One half balanced the other and the wheel remained stationary.

THE secret of failure in all overbalancing devices is the fundamental law that the work done by any weight falling from a given height, irrespective of the path of its descent, never can exceed the amount of energy required to restore the weight to its original position. Again, if you draw a vertical line through the wheels with swinging weights, you will see that more than half of the weights lie on the rising side, thus counterbalancing the advantage in leverage of the other weights and holding the wheel in equilibrium.

At the Massachusetts Institute of Technology, Cambridge, Mass., there was exhibited two years ago a device which seemed to realize the hopes of those who



Buoyancy of water in two water compartments of this endless power machine was expected to drive two interlocking chains of floats, the immersed floats to be pushed to the top.



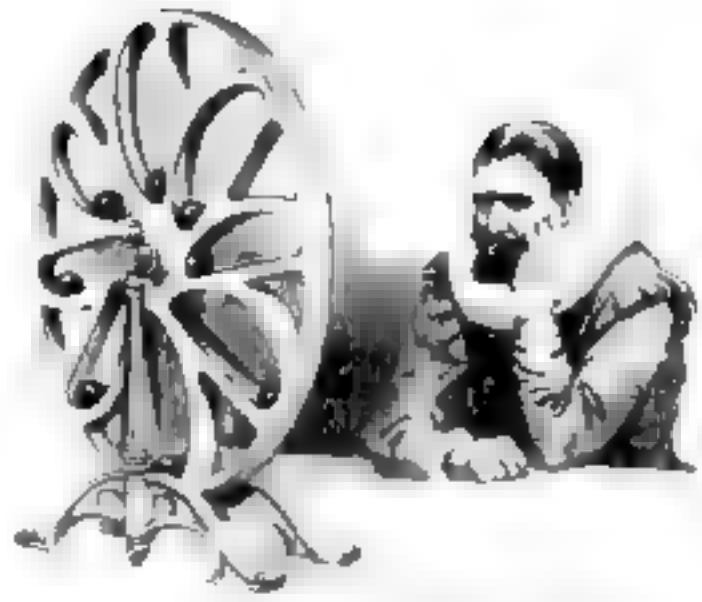
A curious "self moving" railway car invented in 1824. The diagram shows how the conical wheels were intended to make the car climb ascents in the undulating track without raising its center of gravity

put their faith in overbalancing wheels. Once set in motion, a circle of swinging weights whirled for hours. No claim was made, however, that a perpetual motion machine had been built. The exhibit was arranged by a ball bearing manufacturer to illustrate the extent to which friction can be eliminated. Because friction had been reduced to a minimum, the device took longer to "run down" after the initial shove. It was not creating the energy that moved it it just used it economically

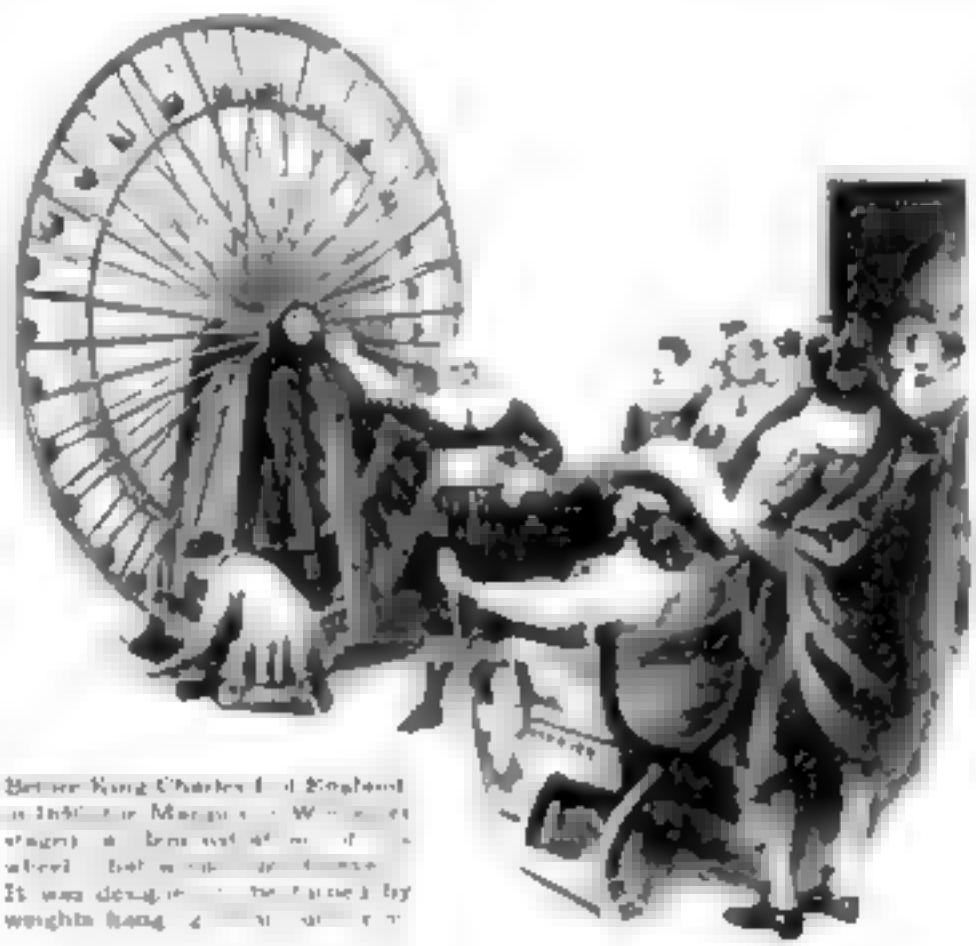
EXACTLY a century ago, an inventor announced he had harnessed gravity so that cars would run without engines on tracks. The wheels of the cars were to be huge cones with the apexes pointing out The track would ascend and descend like that of a roller coaster in an amusement park. As the track rose, the rails would be spread so that the car would ride out near the tips of the cone wheels, thus permitting it to climb the incline without raising its center of gravity. In descending the rails would become considerably narrower causing the car to ride near the bases of the cones without lowering its center of gravity

In this manner the inventor explained, the car would ride up and down the hollows of the track as though it were running on a level. He concluded that, if given an initial push, it would speed along until the operator applied the brakes! "Assuredly," he wrote, "if given a path encircling the earth it shall continue to roll along in one undeviating course till time shall be no more!" The trouble with this, as with every perpetual motion scheme, was that the inventor failed to reckon on friction, which would soon slow down and stop his car, just as it slows down a coasting freight car in a railway switch yard.

Akin to wheels designed to be turned by gravity is a long list of devices seeking perpetual power from the buoyancy of water. The favorite in this class is an endless chain of floats arranged to pass through an upright water compartment in such a way that at any instant half the floats are in the water and half in air The idea is that the submerged floats, rising to the top, will keep the chain moving. Another suggestion is for a submerged wheel with hollow spokes and balloonlike air compartments at their ends. A bellows (operated by the turning of the wheel!) is supposed to pump air continually into the balloons at one side of the wheel, causing that side to rise continually in the water and keep the wheel whirling



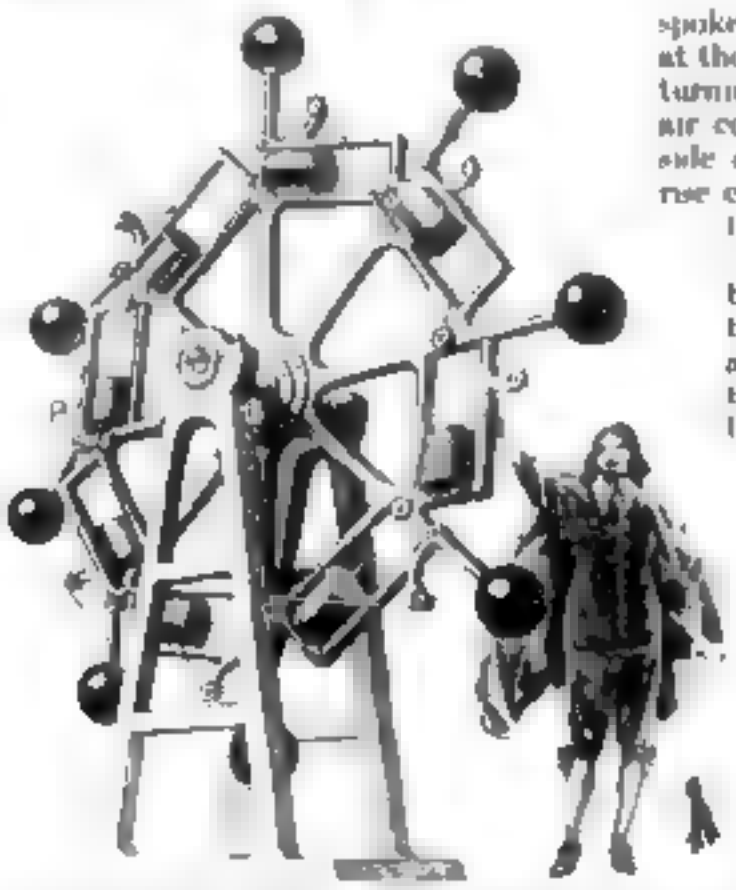
Leonardo da Vinci, the great Italian artist inventor tried to devise a self-running wheel. One trial convinced him that the search for a perpetual motion device was a futile one



Such schemes overlook the fact that the energy required to expand the balloons under water or to open any sort of trapdoor arrangement in the bottom of a water compartment to allow a chain of floats to enter would offset the energy created by buoyancy

A suggestion is often made that the turning of a mill wheel be employed to operate a pump that will lift water to turn the wheel! A machine based upon that idea, with added trimmings, is stored in the basement of the U. S. Patent Office in Washington. It consists of a tank in which falling water operated a turbine. The turbine, in turn, operated a dynamo. The dynamo ran a motor and the motor operated a pump. The pump was supposed to force the water back into the tank and the process was to repeat itself over and over again—only it didn't.

With the discovery of the action of capillary attraction, the mysterious mounting of water in tubes and sponges was employed by Sir William Congreve, a member of Parliament in England, and a famous inventor in an attempt to make a machine run forever Endless belts of weights and sponges were to pass over rollers and through water in such a manner that the fluid would mount in the sponges on only one side of the machine. This weight, continually pulling down, was to keep the belt moving even if very slowly. The idea seemed plausible—as a toy or a laboratory experiment—and the failure of the machine greatly puzzled the scientist, who had underrated the friction of the rollers carrying the heavy weights. Such a device of course, is not a perpetual motion mechanism, since it depends for its action on the absorption and evaporation of a liquid, and the liquid must be renewed frequently.



Overbalancing wheel with shifting weights devised by Sir James Ferguson in 1770 to prove perpetual motion impossible.

USUALLY when a new field of scientific investigation is opened, undiscouraged seekers for perpetual motion hail it as the road to endless energy Magnets and liquefied air have had their many adherents. Only last year, reports of a "fuelless motor for airplanes which was to be run by tapping the waves of magnetism sweeping between the Poles, created wide interest. But the inventor soon sank from sight without having given a public demonstration.

The nearest approach to perpetual motion probably (Continued on page 140)

Unusual Men *in the* Public Eye

SHORTLY before his recent departure on his fifth expedition into the Gobi Desert, in Mongolia, Central Asia, Dr. Roy Chapman Andrews received the Elisha Kent Kane Medal from the Geographical Society of Philadelphia for his outstanding work in exploration. Comparing him with Commander Richard E. Byrd, the last previous recipient of the medal, the Society hailed him as distinguished scientist, great leader, and executive.

These qualities Dr. Andrews has strikingly demonstrated in more than twenty years of scientific exploration—ever since, in fact, he made his first trip to Alaska in 1908. He has gathered whales in the South Seas and penetrated Korea further than any other white man. He traveled, as special naturalist on the U. S. S. *Albatross*, to Borneo and Celebes, in the Dutch East Indies, and a year or two later journeyed 6,000 miles through northern waters to film the life of the seal for the Government. Again voyaging to Alaska with the Borden

Dr. Roy Chapman Andrews, with young owls and eaglets captured during his Gobi Desert explorations.

found. This monster which, Dr. Andrews says, roamed the world some 6,000,000 years ago, was the size of a motor bus. When alive, it must have weighed about twenty tons. It was about twenty-five feet long, fifteen feet high at the shoulders, and had a twelve-foot neck for good measure. The bone between its "elbow" and shoulder measured four feet and had the circumference of a man's torso. The creature's official scientific name is *Baluchitherium*, but Dr. Andrews, with a characteristic sense of humor, called it the "Woolworth."

Some of the implements gathered by the explorer and his party date back 150,000 years. The most interesting finds, however, showed that 20,000 years ago Mongolia was densely populated by a race known as the "dune dwellers," who probably spread into China and Siberia, thence to Alaska and also to Europe. It is to make a further study of this people that Dr. Andrews returns to the Gobi Desert. By tracing its history, he and other scientists believe, he will at last discover the origin of man on earth.

Born forty-five years ago in Beloit, Wis., Dr. Andrews was only ten years old when he determined to become a naturalist. At Beloit College, and Columbia University, New York, he studied zoology.

Twenty-three years ago he applied for a job at the office of Dr. Herman Carey Bumpus, then director of the American Museum. When told there was no opening, he said he was willing to wash floors! Impressed by his spirit, Dr. Bumpus made a place for him in the taxidermy department of the institution. Here he actually did wash floors more than once.

"But I did not mind it a bit," says Dr. Andrews. "I was happy to be in a building in which men worked who to me were as gods."

Jack Miner, world authority on bird lore and originator of sanctuaries for the songsters.

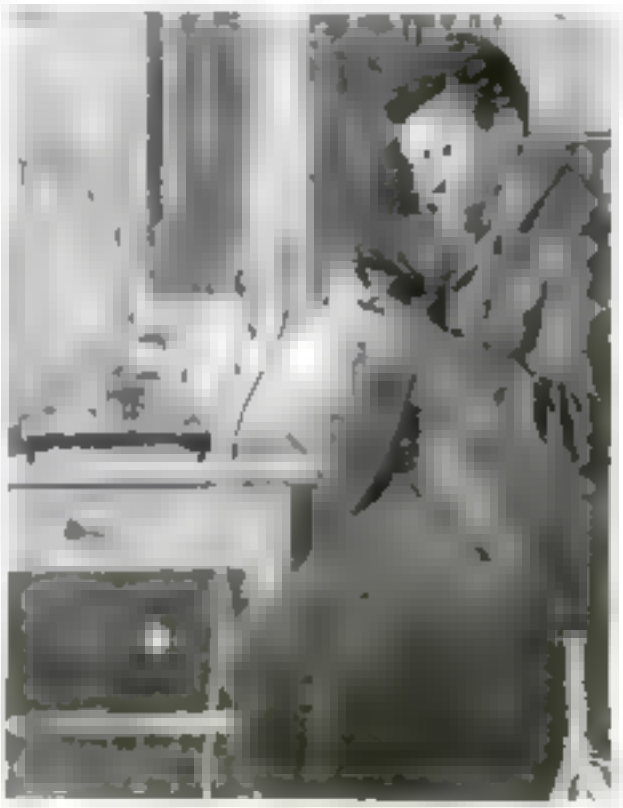
expedition in 1913, his study of whales and other water mammals made him a leading authority on that subject.

But it is as the leader of the famous Central Asiatic expeditions of the American Museum of Natural History, New York, that he has won greatest distinction. Dr. Andrews was the first man to venture by flivver into the desolate Gobi Desert. He returned with fossils of the oldest known mammals, also dinosaur eggs estimated to be a million years old and extensive evidence pointing to the Mongolian plateau as the cradle of humanity.

From his fourth trip to Central Asia he returned to America last November with eighty-five crates of fossils. Among them was the skeleton of the largest land mammal of which remains have been

Edison's Nearest Rival

IN THE U. S. Patent Office at Washington, a good-sized section of shelf space is taken up by the inventions of Ethan I. Dodds. They fill eight large volumes; and almost every one there are more than 2,000 now in practical use. And it's a safe bet



Dr. Paul Ditisheim. Through his work watches that never kept time now run right on the dot.

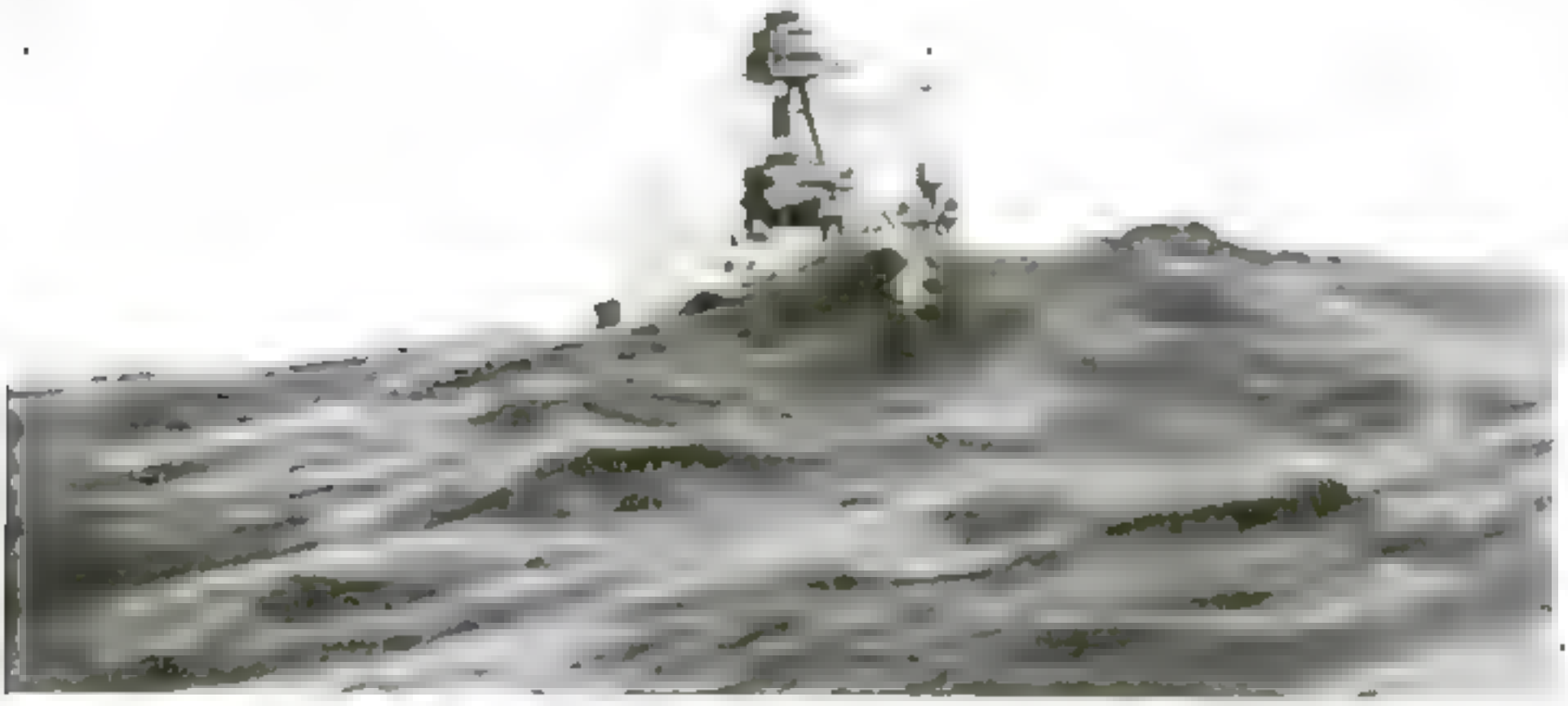
Ethan I. Dodds, next to Edison the most prolific inventor. He has 2,000 to his credit.

that several have made life easier for you.

This extraordinary number of original devices Dodds has perfected in a little more than twenty-five years, which is at the rate of about eighty a year, or one and a half a week, or one every four days or so! Yet the man who conceived them could not read with any degree of fluency until he was twenty-one, though he cannot remember the time when he couldn't grasp the secret of an intricate blueprint at a glance. Once he was admitted on probation to a small college. At the end of the first week, the president asked him to leave. "I am sorry, Dodds," he said "but we cannot do anything for you."

The college president was probably right. Probably the institution could not have improved upon Nature, which had endowed Dodds (Continued on page 1..)

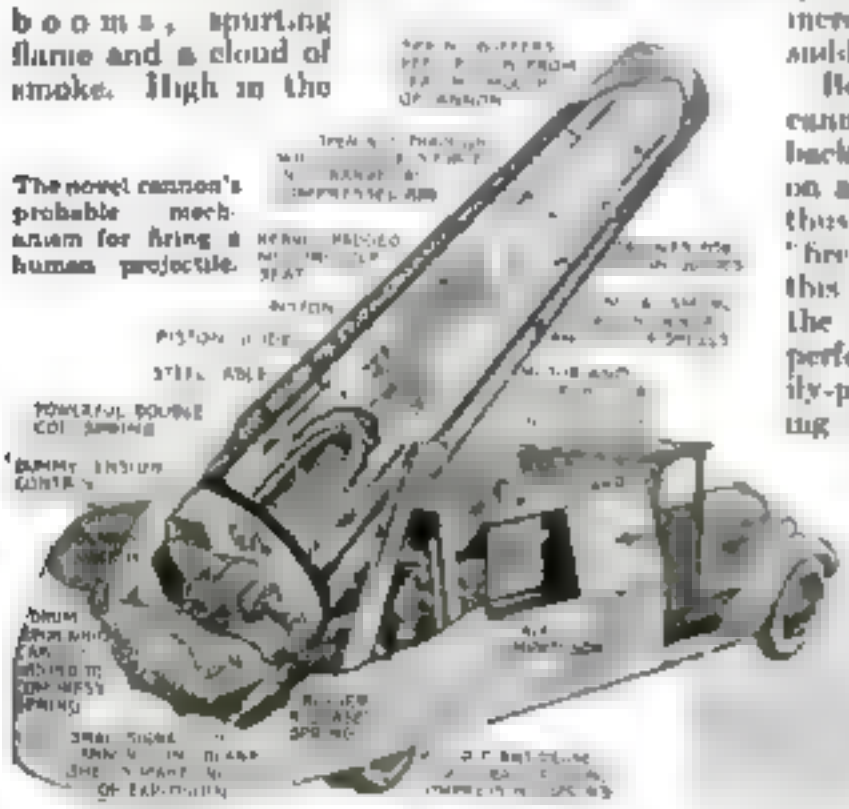
Flagship of U. S. Fleet in Battle with Big Seas



Sinking? Not by a long shot. This remarkable photo shows the battleship *Texas* plowing through mountainous waves during recent battle maneuvers off the California coast. Built in 1914 at a cost of more than $11,000,000, the *Texas* can fire a 14,000 pound broadside.

Explaining the Mystery of "Human Cannon Ball" Circus Thriller

A NEW thriller of the big top is featured in circus performances this season. It is the "human cannon ball." While the audience waits in breathless suspense, a slim figure in a leather flying suit slips down the throat of a huge cannon. A few moments later, the cannon b o o m s, spurting flame and a cloud of smoke. High in the air a somersaulting object takes human shape and drops lightly into a net a hundred feet from the cannon's muzzle.



The novel cannon's probable mechanism for firing a human projectile.

Exactly how this hair-raising stunt is accomplished is a closely guarded professional secret. However, after talking to circus attaches and observing the operation of the gun, our artist has been able to illustrate the probable mechanism that performs the spectacle.

As the accompanying drawing shows, an electric motor within the body of the truck on which the cannon is mounted elevates the gun to the correct angle for firing its human projectile into the distant net. Within the cannon barrel is a platform which acts as a piston to drive the performer out. Four projections along the sides of the piston slide in grooves in the cannon barrel. Spring buffers at the cannon's mouth prevent the piston-platform from leaving the gun. Behind the piston probably is a powerful double spring, designed to give a push of increasing speed rather than a sudden drive.

Before the performer enters the cannon, the platform is drawn back by a heavy steel cable wound on a drum by an electric motor, thus compressing the spring. To "fire" the cannon, a trigger on this drum is pulled. It releases the spring and shoots out the performer, who sits upon a heavily-padded motorcycle seat, bracing his feet on the cushioned platform, at the same time steadying himself with padded arms against the smooth walls of the cannon barrel.

The noise of explosion is supplied by a small signal cannon hidden in the body of the truck. It goes off when the trigger is pulled. Chemicals at the mouth of the cannon produce a realistic flash just as the human cannon ball shoots out, while smoke that pours from the muzzle is produced by chemicals forced into the barrel through openings from chambers between its inner and outer shells.

Flyer Somersaults Twice in a Day, and Lives

LANDING upside down twice in the same day was the recent unusual experience of Emile Burgo, a test pilot at Curtiss Field, N. Y. In the morning, a Fokker monoplane was flipped on its back by a gust of wind as he was taxiing it across the field. In the afternoon, a sport plane he was piloting wabbled in a thirty-mile wind, barely missed crashing into a row of hangars, and somersaulted upside down in landing on rough ground. Nobody was injured in either crash.

The mysterious circus cannon in action. The big gun booms, spurting flame and smoke—and Hugo Zacchini, the "human cannon ball," is hurled high into the air, to land safely in a net 100 feet away.

Surgeons Used These Tools 2,000 Years Ago

SURGEONS of 2,000 years ago used instruments similar in shape to those of today. This was shown by probes and forceps uncovered in the buried city of Pompeii, Italy, and recently exhibited in London, England. The large number of probes in comparison to the other instruments of the collection suggests that cutting was a large part of surgical work before A.D. 79, when the eruption of Vesuvius buried the Italian city.

While the shapes of the ancient instruments in some cases are almost identical with those of the modern surgical tools, their steel is less flexible. The absence of saws from the collection indicates that amputations were rarely attempted, largely because of a lack of knowledge about circulation of the blood.

Surgery is known to have been practiced at an early date. When Alexander the Great invaded lands east of the Mediterranean, in 300 B.C. he found it being practiced by the natives with great skill. There is evidence that surgery was in use in Egypt as early as 3000 or 4000 B.C.

New Serum Substitute for Blood Transfusions

BLOOD transfusions may be made unnecessary in many cases by the discovery of a new serum in France. At a recent meeting of the French Academy of Sciences, it was announced that Dr. Leon Normet, an army surgeon, had produced a serum which will rapidly multiply the number of blood corpuscles in a patient's life stream. The basis of his remarkable discovery is said to be certain salts from citric acid.

In making transfusions, doctors have found that if the corpuscles in the blood of the donor and the patient are not alike, the operations are unsuccessful. It is said that the unlike corpuscles fight for dominance and usually those in the fresh blood of the donor defeat the tired corpuscles of the patient's body, thus lowering his power of resistance. Even with the aid of a microscope, it is not always possible to ascertain beforehand whether blood used in a transfusion is entirely satisfactory.

While the new serum is not expected to take the place of transfusions where the blood of patient and donor are alike, it is believed that it will save lives in cases where no satisfactory donor can be found or where the necessary operation cannot be performed at once.

Dr. Normet's serum was tested upon 100 dogs which had lost large quantities of blood, and all but five recovered. Tests upon human beings are said to have proved entirely satisfactory, and the discovery has been adopted for use in several Paris hospitals.

New Electric Saw Makes 29 Different Cuts

TO TAKE the drudgery of hand sawing out of the home workshop, a light electric circular saw has been designed which can be turned at any angle and which is said to allow speedy cutting in such exacting work as mitering, dadoing, grooving, and tenoning. It performs twenty-nine distinct cutting operations, the makers say.

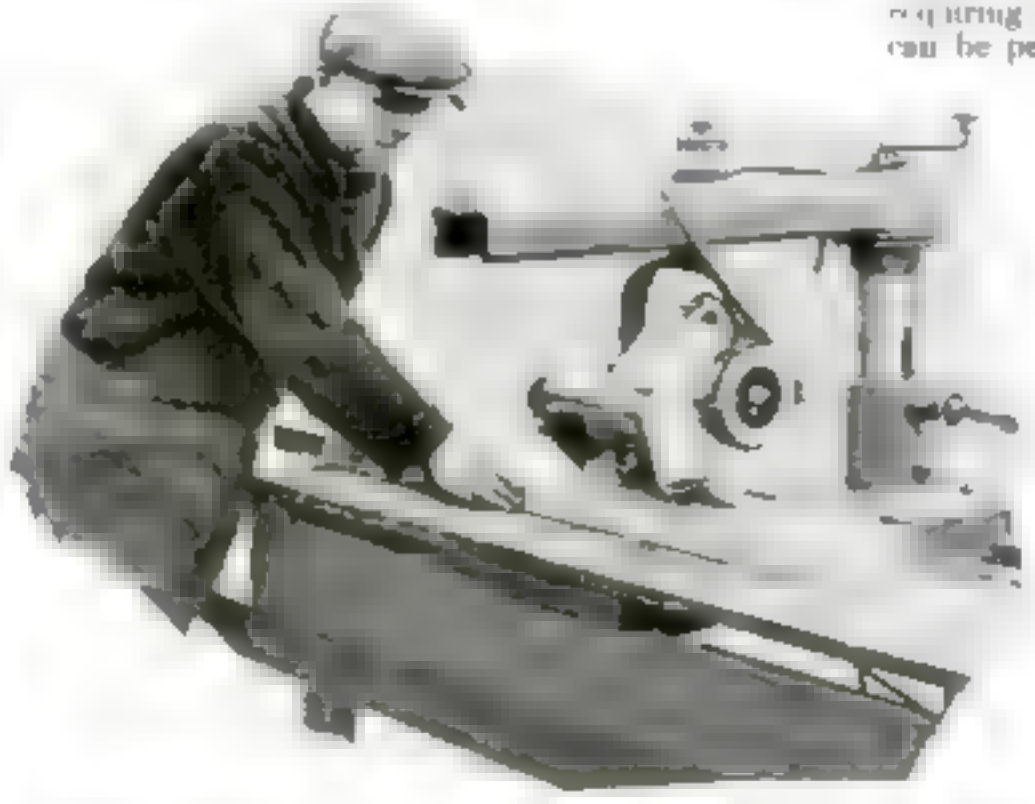
The saw is designed to act as either a crosscut or a rip saw, so that an operation requiring ripping and cutting into pieces can be performed without stopping the motor. The saw can be pushed out or in on the arm supporting it, and this arm can be rotated and also raised or lowered. The swivel by which the saw is attached to the arm allows it to be turned either on its lateral or transverse axis, gages permitting the correct angle to be set.

A guard over the twelve-inch circular saw protects the worker, and ball bearings in the arm increase the ease with which the machine can be operated. The speed of the saw is said to be such that it cuts twenty feet of two-inch stock a minute. The complete machine, with table, weighs 235 pounds, and can be carried about by two men.

Japanese Taller in America

THAT changes in environment alter the stature and physical characteristics of a race is shown by recent studies of Japanese born in America and those living in their native land, made by Dr. Leslie Spier, anthropologist at the University of Oklahoma.

The American-born Japanese, he found, grow taller, have larger heads, and are more precocious than natives of the island empire. Their more rapid physical development is shown, Dr. Spier declares, by the fact that they acquire adult teeth at an earlier age. The principal factors in such changes, he says, are differences in food and water.



Ripping a plank on an angle with the new electric saw. The saw can be moved along the supporting arm, and, through swivel attachment, can be set at various angles.

Novel Uses for Tantalum, Silvery-White Metal

WITH the announcement that a leading watch manufacturer has commenced making cases and straps for wrist watches of the silvery-white metal tantalum, experts are asking what other uses may be found for this versatile yet little-known substance.

Tantalum is a chemical element, just as iron or nickel is; yet until recently it has been practically unknown in commerce. It melts at the high temperature of 5,000 degrees F., only a little less than the heat of the oxy-acetylene blowtorch, if heated in a vacuum. Heated in the air, it first turns blue, then nearly black, and finally burns. Its most interesting property, however, is its extraordinary resistance to corrosion by almost all sorts of industrial and other liquids.

Recently spinnerets made of tantalum have been used in rayon or artificial silk factories. It recommends itself for surgical and dental instruments, because it is not tarnished by antiseptics or other chemicals. Since it can be drawn into a fine wire of great strength, tantalum has been employed in making the filaments for certain types of incandescent electric lamps and its use has been suggested in radio tubes. Electric rectifiers for charging storage batteries from an alternating current source give satisfactory results with electrodes made of tantalum. Another important application is in electrical methods of analysis in chemical laboratories. Gold and silver deposited on a strip of tantalum can be removed with aqua regia, a powerful mixture of acids, without attacking the tantalum.

This Hillside Home Has a Stairway of Fountains

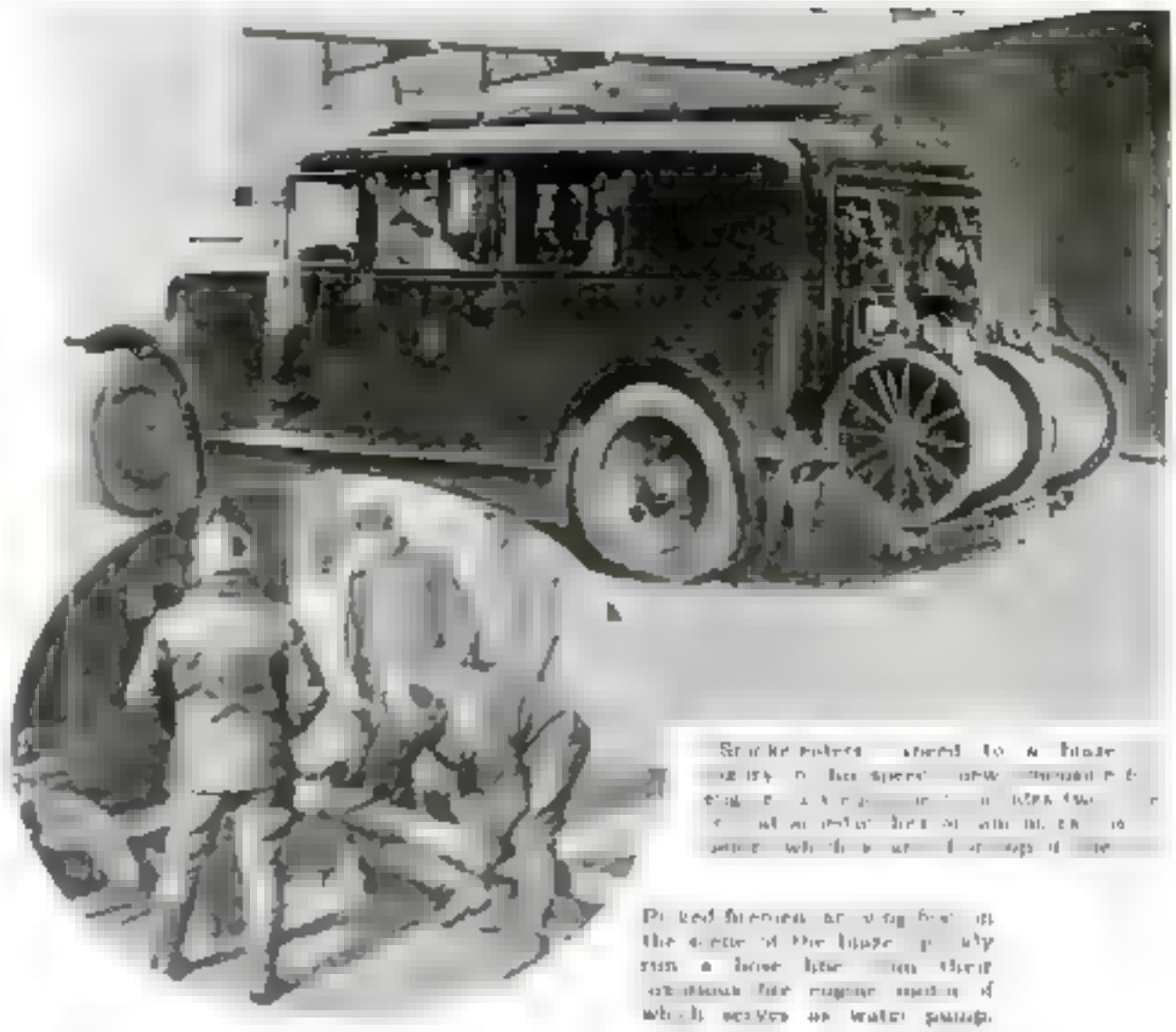
A STAIRWAY with forty fountains leads to a hillside home in Los Angeles, Calif. Each of the tile-lined pools, one for every few steps, contains aquatic plants and flowers, which provide a variety of interest to those who make the tiresome climb up the long flight of steps from the street below the house.

The fountains are constructed of cement and varicolored stones, chosen to match the color scheme of the tiles in the stairway. Water trickles from one fountain down to the next and finally reaches the ground and disappears.

Bantams Aid in War on Insect Pests

BANTAM chickens have joined the war against the Japanese beetle, the destructive orchard pest that came to America as a stowaway in a bunch of iris roots from Japan. A greenhouse owner near Philadelphia has recruited a flock to rid his meadows of the beetles. The bantams devour the insects as fast as they emerge from the soil, it is reported.

Previously these lively little chickens had gained a reputation by cleaning up the strawberry root worms in another greenhouse that was afflicted with the pests.



Stroke pulses speed to a limit... Its speed... engine... to 1,000 r.p.m. ... which is ... of the

Picked firemen ... from the ... run a hose ... obtains ... engine ... which serves as ... pumps.

Limousine Fire Engine the Latest in Paris

PICKED fire-fighters of Paris, France, now respond to alarms in a gleaming limousine instead of on a truck. Col. M Pouderoux, commander of the Paris firemen, recently put a speedy enclosed machine into service. He believes it will enable a crew of skilled men to reach a fire before the larger trucks arrive and in many cases to get it under control before it causes great damage. The machine also protects the men from rain and cold during bad weather.

Carrying as large a crew as an ordinary truck, the unique fire engine also transports a surprising amount of equipment. An extension ladder fastened to the top can be pulled off over rollers in a jiffy and two hose reels at the rear permit the laying of the water connections as soon as the car comes to a stand. At the scene of the fire, the limousine's motor pumps the water through the hose.

Up the center of the long flight of tiled steps to this California home may be seen the series of fountains.

Electricity May Have New Rival in Industry

IN THE opinion of Dr. Joseph S. Ames, noted physicist and provost of Johns Hopkins University, the little-talked-about force of "capillarity", within a decade or two, may rival electricity in value.

Capillarity is a strange attraction between two substances in close contact between liquid in a narrow tube and the tube itself, for example. Its secret lies in the attraction between the molecules of the two substances. It is the force that makes water rise of its own accord up a glass pipe, of hairlike bore, in apparent defiance of the laws of gravity. Among its many practical uses, it enables porous charcoal to "suck in" and absorb noxious vapors from the air, as in wartime gas masks.

These effects have long been known. It remained for two Johns Hopkins professors of chemistry, Drs. J. C. W. Frazer and Walter A. Patrick, to discover the other day, that the little-known force is many times more powerful than has been dreamed. Their study, requiring them to measure liquid films as thin as four billionths of an inch, upsets all previous notions about capillarity. They suspect that with further research it may be harnessed as a revolutionary force of untold value to industry.

Card Holder Aids Memory of Bridge Novices

TO AID bridge players, especially beginners, who have trouble holding their cards or remembering the bid or trump, O. A. Youngren, of Los Angeles, Calif., has devised a celluloid card holder held by a finger loop on the back.

On its face are sliding indicators that show the bid and trump and the number of tricks necessary to win or the number necessary to set an opponent when he has the bid. After each hand, the indicators are moved so that the correct information can be obtained at a glance.

Einstein Presents Theory in Simpler Terms

A MORE "popular" presentation of Prof. Albert Einstein's new field theory uniting laws of gravity and electricity has recently been submitted to the Prussian Academy of Sciences by that distinguished physicist himself.

Though the revised text is by no means easy reading, it is said to be a little more comprehensible to most scientists than the six-page leaflet which recently announced Einstein's latest discoveries, described in the April issue of POPULAR SCIENCE MONTHLY. It was said then that scarcely a dozen men in the world could understand the treatise.

The original text abandoned classical mathematics and set forth Einstein's sensational conclusions about the behavior of objects, time, and space in a system of geometry largely devised by Einstein himself. In the present work, entitled *The Uniform Field Theory and the Hamiltonian Principle*, the Berlin physicist has expressed his conclusions by the more familiar mathematical methods developed by the English mathematician, William Hamilton.

A READER of POPULAR SCIENCE MONTHLY who enjoys figuring sent us this the other day: "If I had to delve into books for all the information contained in one issue of your magazine, the stack of volumes I'd have to peruse would be as large as the Capitol dome in Washington. This is actual calculation."

Tests Vindicate Some Old "Home Remedies"

SOME of the old home remedies represent the experience of generations of suffering humanity and actually possess healing qualities. This was demonstrated recently in a series of unique experiments conducted at Flower Hospital in New York City.

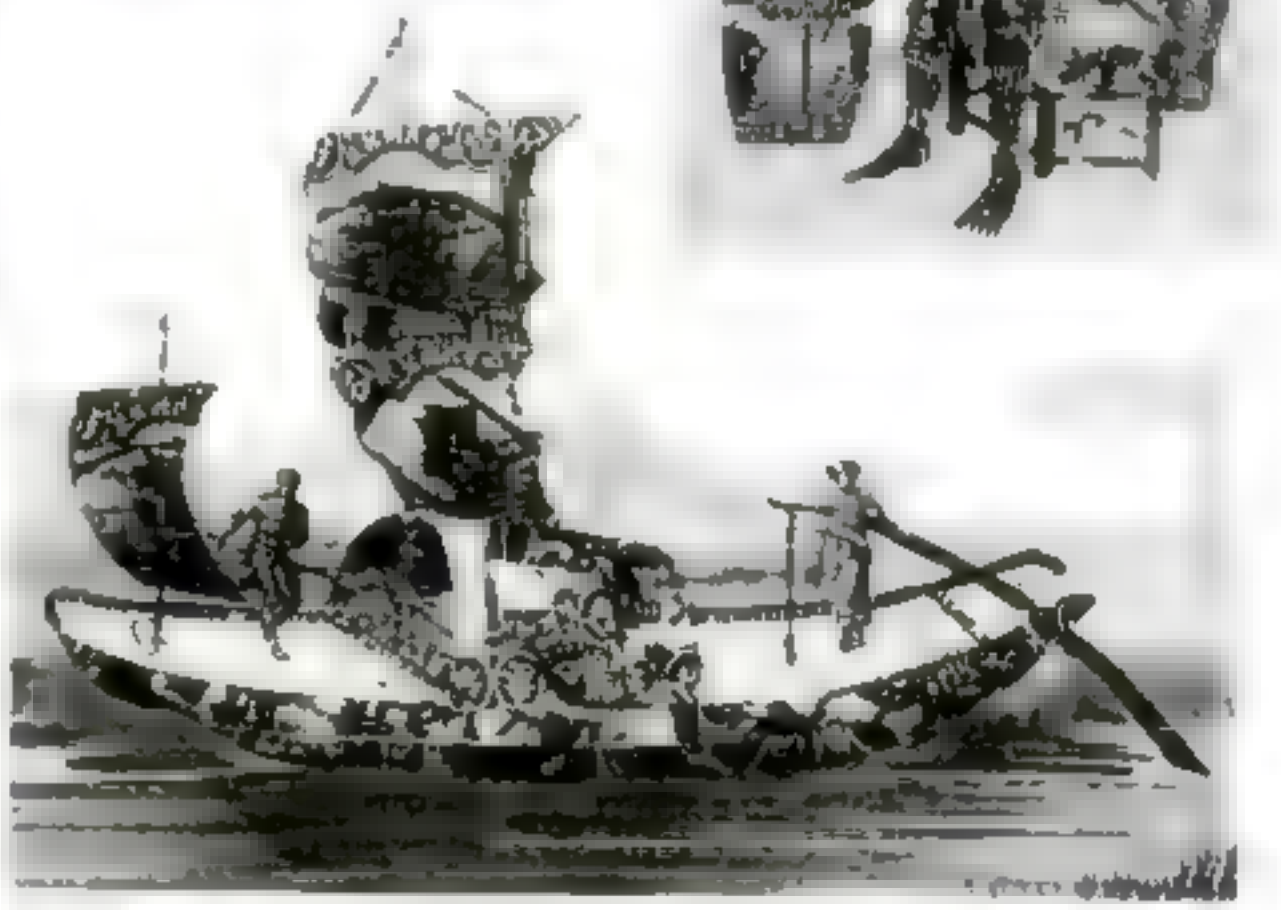
The principal "unscientific" remedies tested were the juice of wild indigo, which is in high favor with natives in various parts of the world as a cure for typhoid fever; bryonia, an extract of a wild hop plant, regarded by African savages as an effective drug in cases of pneumonia and dropsy, and the bee-sting treatment for rheumatism in which the peasant folk of Europe have believed for hundreds of years.

The experiments with the wild indigo extract, or baptisia, proved the most successful. Dr. Linn J. Boyd, professor of medicine at the New York Homeopathic Medical College, fed baptisia to a number of rabbits. He then took a blood serum from the animals, diluted it with water, and this solution he used on a culture of typhoid fever organisms. In a microscope test it was shown that the serum caused the typhoid bacilli to "clump" together, and soon killed them.

To determine the value of bryonia as a pneumonia remedy, Dr. Boyd inoculated scores of rabbits with pneumonia germs. Four out of every five which did not receive the bryonia treatment died. But of the rabbits given the hop extract, three out of every five survived.

In the bee-sting remedy experiment, bees were shaken violently in a bottle, to make them angry and thus induce them to manufacture a generous quantity of poison. Then the insects were placed in alcohol, and an analysis showed that formic acid was the main ingredient in bee poison. Rheumatic patients after receiving injections of this chemical showed marked improvement.

Many other old home remedies tested, however, were found wanting.



Chinese Artist "Paints" with Postage Stamps

ON THE island of Formosa, an obscure Chinese artist has evolved a new kind of art, using fragments of postage stamps to create colorful pictures. This unknown artist first sketches in his scenes and then fills them in with pieces of stamps, choosing those that will give him the colors he desires.

Decorative post cards bearing his unique pictures recently reached America. One shows an Oriental cobbler bending over his last, mending a shoe. Another scene, similarly created, pictures a Chinese royal barge with sails set.

In the United States, postage stamps of various denominations and colors have been employed from time to time to form decorative designs for dishes, ash trays, and similar objects. The idea of using stamps for color effects in paintings, however, is quite unique.

Headphones in Theater

SEATS supplied with headphones, so deaf people can hear every word spoken on the stage, have become part of the equipment of two theaters in Paris, France. The patron who desires the use of phones makes application for them when he purchases his ticket. Arriving at his seat, he plugs the flexible cord of the instrument into a socket in the back of the seat.

Now 20,000,000 Radio Sets in the World

YOUR radio set is one of 20,000,000 receivers in use in the world today, and one of 10,000,000 being tuned-in daily and nightly in the United States, according to a survey completed by the Department of Commerce at Washington.

Radio, within comparatively few years, has become a universal institution. Literally "from Greenland's icy mountains" to the Antarctic, people are turning the dials of their sets to catch programs of music and entertainment. There is not a minute in the twenty-four hours when radio programs are not being broadcast and received somewhere.

Broadcasting stations are operating near the Arctic Circle, on the equator, and far down in the Southern Hemisphere. The highest powered foreign stations are all in Europe. Russia and Finland maintain stations of 40,000 watts; Sweden has stations of 30,000 and 20,000 watts, France has one of 20,000+ and the largest British station is one of 16,000 watts. In all, Europe has more than 200 broadcasting stations; there are sixty-two in South America, twenty-five in Australia, and seven in Japan.

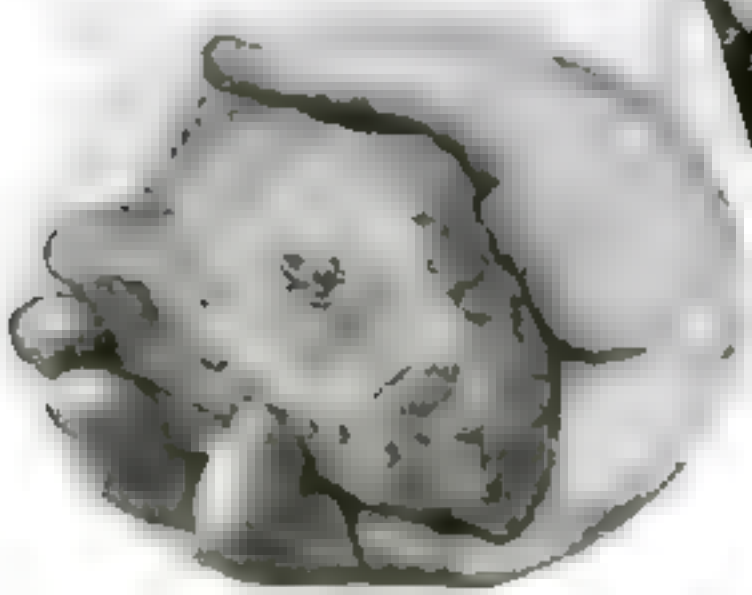
The total of 10,000,000 sets in the United States is far in excess of that in any other country. Great Britain and Germany have about 2,500,000 each. France has 1,250,000; Japan, 550,000, and Argentina, 330,000.

In most foreign countries, owners of radio sets must pay a government tax. The lowest is levied in France, where fans pay five cents a year, and the highest – $18 – is paid by the citizens of the Central American republic of Salvador. British fans pay their government $2.45 a year each; Germans, $5.70; Australians, $5.85, and the Japanese about $9.

American exports of radio equipment have increased steadily and last year reached the record figure of $12,000,000. The total value of radio supplies sold by this country in foreign markets during the past seven years was $50,000,000.

Giant African Bullfrog Weighs Ten Pounds

Leon L. Walters, of the Field Museum, Chicago, compares an artist's study of his bullfrog model with the life-size model of the African giant



The world's smallest frog, from Cuba. It would take 20,000 of them to equal the African bullfrog in weight.

FROGS' legs as big as mutton chops are provided by the world's largest species, living in Africa. It weighs about ten pounds. The North American bullfrog rarely reaches a pound and a half. Negro tribes in Southern Cameroon and French West Africa consider the giant frogs a rare delicacy and preserve the thigh bones for use in religious ceremonies. Consequently, these oversize amphibians are exceedingly rare, and only a few of them have been brought back to civiliza-

[illegible] placed in juxtaposition. A model of one of the giants in the Field Museum of Natural History in Chicago. It recently was placed beside that of an ordinary American bullfrog. The latter was dwarfed in comparison. In the Museum collection is also a model of a midget frog believed to be the smallest in the world. A native of Cuba, it is so tiny that it just equals three grains of wheat in weight. An army of twenty thousand of these flyweight frogs would be required to balance the scales against the African jumbo.

Leon L. Walters, of the Museum staff, made the frog models by a special process he has developed. Casts are made directly from the frog's body so that the replica is accurate in every detail. Besides being durable, the colored models are said to be more lifelike than stuffed specimens.

Auction Bridge Taught by New Solitaire Method

TO ENABLE a beginner to learn how to play bridge by himself without the aid of an instructor, a novel system of stickers has been evolved. At the top of each card is pasted a sticker designating to which of four practice hands—"north," "south," "east," or "west"—that card belongs. It also tells how and when the card should be played, whether it is a leading card, and whether it takes the trick. The sticker for the ace of spades, for example, bears the instructions that it belongs in the "south" hand, that it is played on trick number six, and that it wins the trick.

The novice plays all the cards, following the instructions on the stickers and analyzing the reasons for each play. Thus he learns how experts would play the game.

The advantage of the sticker system of teaching bridge, the inventor states, is that it allows the beginner to practice by himself as often as he desires and permits him to stop frequently to discover the "why" for any given play.

One set of stickers illustrates how a "trump bid" should be played, while a second set shows the manner of playing a "no trump bid."

New Electric Lamp Bulbs Clean Themselves

SELF-CLEANING lamp bulbs are the latest in electric lighting. Designed in the incandescent lamp department of the General Electric Company at Cleveland, O., they are intended to end the evil of blackening in high powered incandescent lamp bulbs such as are used for airport beacons and for picture-taking in talking movie studios. Formerly, after a few hours' use, bulbs became coated inside with a black soot from the heated tungsten filament. This not only cut down the light, but absorbed heat and ruined the glass.

Now a tablespoonful of coarse tungsten powder is dropped, loose, into the bulb when it is made. When the bulb blackens, it is necessary merely to shake it and the loose powder "sweeps" the inside clean.

The editor of POPULAR SCIENCE MONTHLY will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue.

Outboard Motor Boats Race in Swimming Pool

A MOTOR boat race in a swimming pool was held a few weeks ago in Florida. Two tiny speed boats, their outboard motors humming, raced about the pool and cut through the water for a nose-and-neck finish. This is believed to be the first time that a motor boat race had been attempted in an inclosed pool.

The new sport requires expert handling of the boats to avoid capsizing or crashing into the walls. Motor boat enthusiasts believe that in this manner novices may be taught the fine points of racing by experts during winter months to prepare them for the summer races.

It is nearly thirty-five years since the outboard motor was invented, but only during the past few years has it attained great popularity with racing fans. Outboard craft of the latest models were pictured last month in POPULAR SCIENCE MONTHLY. At Peoria, Ill., last year a little boat, powered with one of these motors, attained a speed of more than forty miles an hour.

Model Shows Huge Anchor for Hudson Bridge

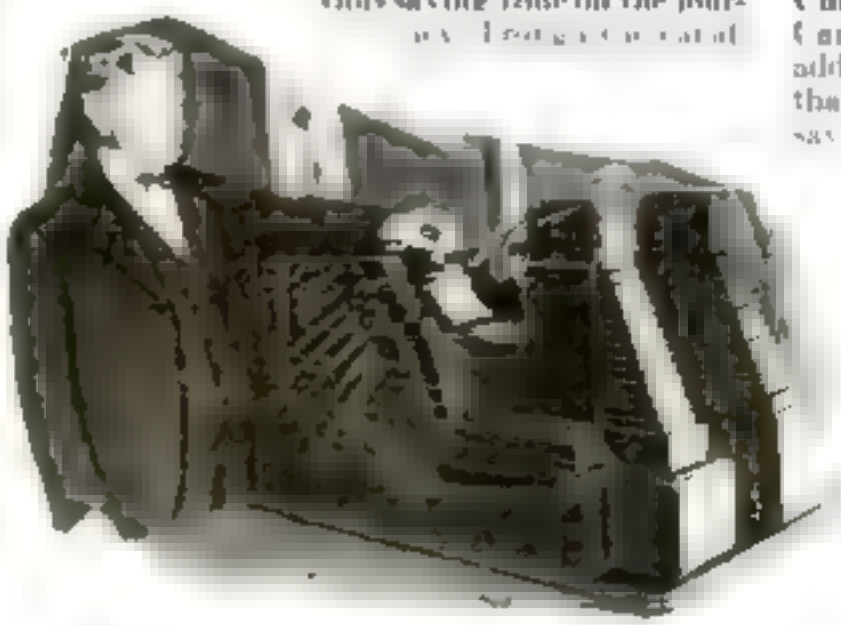
HOW the world's longest suspension bridge will "brace its feet" is illustrated by a model of the anchorage block of the new Hudson River Bridge which, when completed in 1931, will connect Fort Washington, in New York City, with Fort Lee, in New Jersey. The model was made by Robert Hoppen, Jr., one of the engineers in charge of constructing the record-breaking span.

On the New Jersey side, the rock wall of the Palisades gives a solid anchorage for the massive cables, three feet thick, which will support the 3,500-foot span between towers. These cables are to be strong enough to withstand a pull of 65,500,000 pounds. On the New York side, however, a concrete block as high as a fourteen-story building had to be made to hold the eyebars for attaching the main cables. Between 500 and 1,100 cubic yards of concrete were poured into the molds each day in building this massive anchorage.

Giant Elevator Will Lift Thousand-Ton Vessels

A GIANT elevator, on which vessels weighing 1,000 tons may be lifted as much as 100 feet into the air, will be part of the equipment of a canal connecting Berlin with Stettin, the German seaport on the Baltic. Called the largest of its kind in the world, it will replace four locks at Niederfinow, near Berlin, and will cost about $6,000,000. The foundation is under construction and is expected to be completed during 1929.

The above model, built on a scale of one foot to fifty, shows how the elevator will appear when completed. Its advantage over locks lies in the speed with which it performs the lift, thus saving time on the journey [illegible]



Model of massive concrete anchorage block for new Hudson River Bridge, with Robert Hoppen, Jr., engineer who built it

Fight Fire by Freezing It with "Fizz" Gas

THE kind of gas that puts "fizz" in your soda water, carbon dioxide is being used by the Los Angeles, Calif., fire department to "freeze" fires. It is carried under high pressure in cylinders. When released, it shoots out in a cloud of below zero snowflakes that reduce the temperature [illegible] and smother the flames by [illegible] A special truck has been designed for the department to carry the battery of cylinders that forms the latest [illegible] in the battle of science to reduce the huge annual loss by fire.

Some time ago a test of carbon dioxide gas as a flame extinguisher was made in Germany. Since then, other tests have been conducted in several parts of the United States. The addition of the gas unit to the California fire-fighting equipment is expected to prove valuable in combating chemical, paint, and oil fires, where streams of water are of little use.

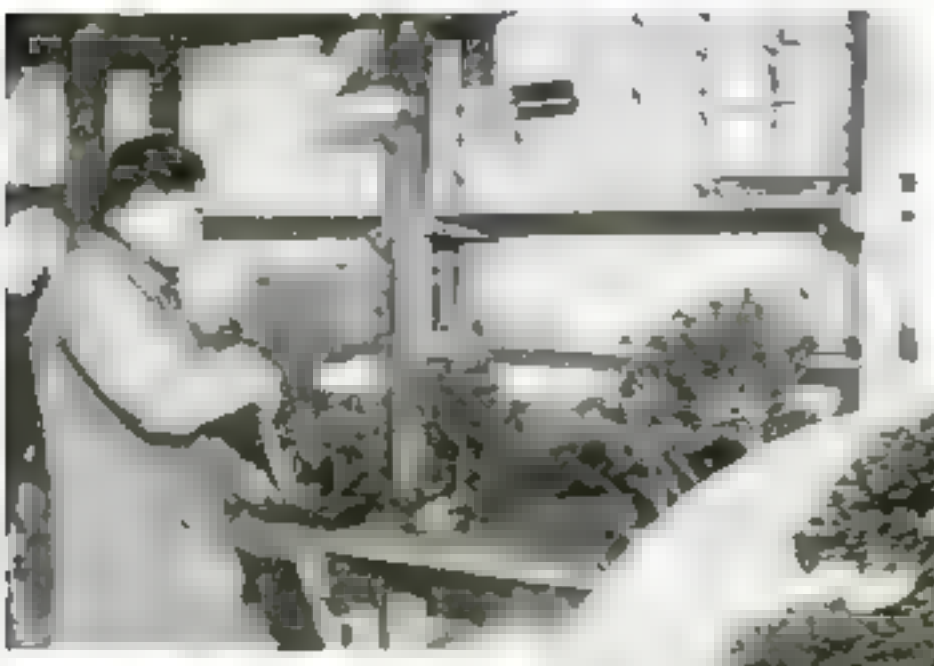
Advances New Theory for Color Blindness

OCULISTS for years have attributed color blindness to three general causes—absorption of certain rays by the eye, nonexcitability of the optic nerve fibers by light rays of a certain wave length, or imperfection of the color-perceiving apparatus in the brain.

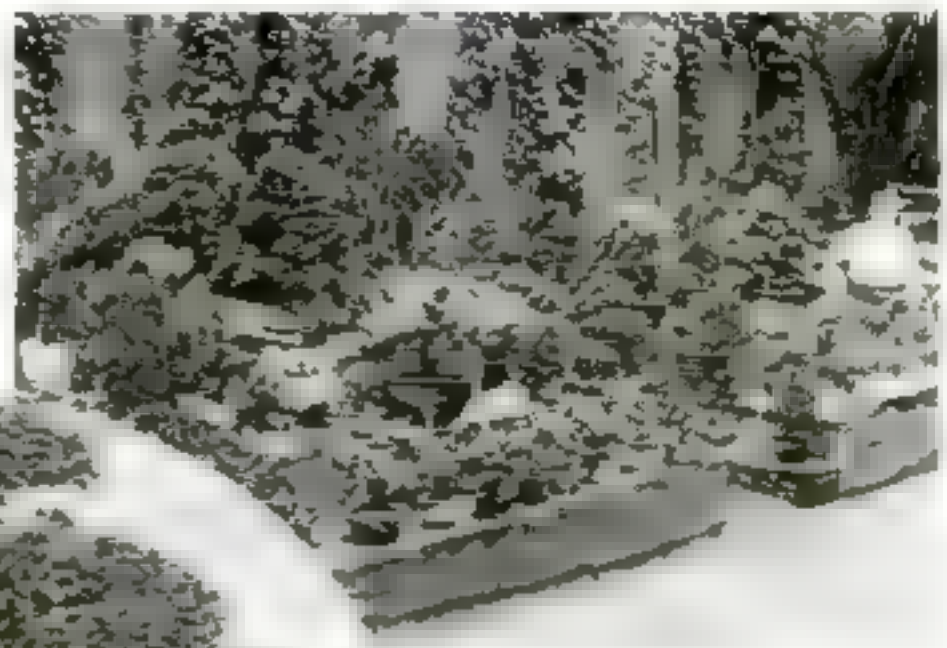
Recently Prof. Frank Allen, of the University of Manitoba, at Winnipeg, Canada, propounded a new theory. In addition to the apparatus in the brain that receives messages from the eye, he says, are two nervous mechanisms which send messages to the retina in the eye. One of these mechanisms causes the sensitivity of the eye to decrease in case of the reception of strong red, green or violet light, the other increases it in case the colored light is weak. The proper balance of these strengthening and weakening impulses becomes disturbed in some individuals, says Professor Allen, and this causes color blindness.

Color blindness has been observed to be more common in men than women, in a proportion of more than three to one.

Forest of Odd Dwarf Trees Grown by "Surgery"



Performing a delicate surgical operation on a dwarf tree



A [illegible] Tom Thumb trees

The gnarled dwarf tree has been living for seventy-five years yet is only eighteen inches tall. The gnarled effect was produced by weights.

GNARLED and twisted, a dwarf tree [illegible] of a century was exhibited recently in Paris. Its height was only a few inches greater than the length of this page. Similar dwarf trees, produced in Japan are said to have lived a hundred years without growing as much as an inch!

An amazing forest of such Tom Thumb trees is located in a horticultural garden near the French capital. A science known as "nanosation" produces them. Through delicate "surgical" operations on the roots and by semi-starvation, shoots of normal trees are stunted so they reproduce all the characteristics of forest giants without attaining a height of more than a few inches.

The process begins when a young shoot is placed in a small pot which restricts the roots and prevents them from growing too large. Then the main, or central, root is bound tightly with a wire underground at the point where the trunk begins. This wire gradually chokes the root to death. The secondary roots are trained to creep near the surface of the small amount of soil provided, so that partial starvation results.

As the outer roots grow, other surgical operations are performed every two or three years until all but three or four are choked off.

The gnarled appearance of an ancient tree is given the dwarf by tying weights to the tiny limbs. When the weights are removed, after several years, branches remain permanently bent.

The science of dwarfing trees has reached its highest development in Japan, where it has been practiced for centuries, and where the process was invented. The patience required to produce the diminutive trees makes them very expensive.

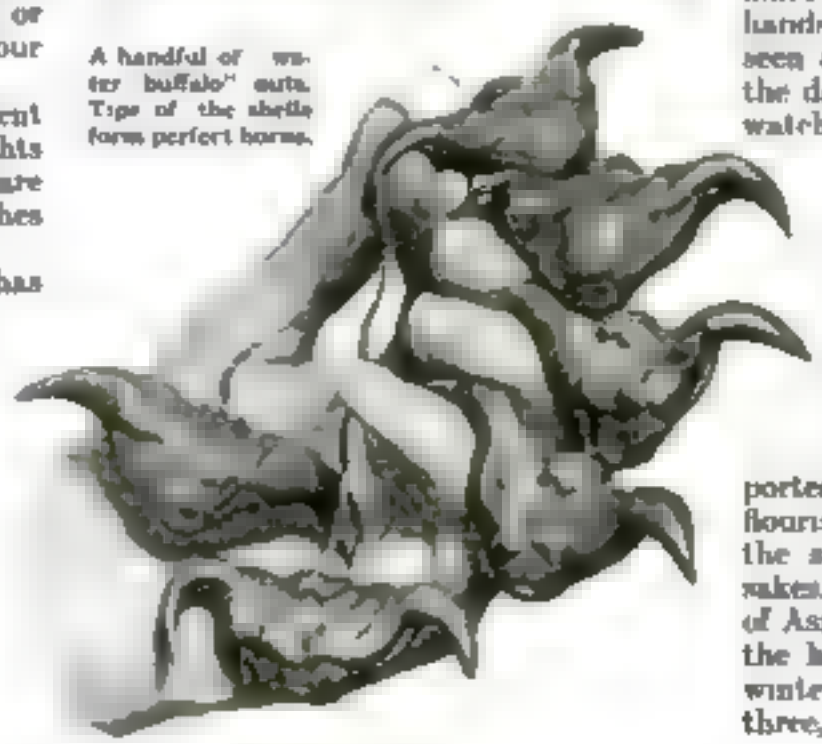
Useful New Plants

AMERICAN plant hunters, after searching the jungles of Madagascar, off the African coast, have returned with twenty-three rare plants and trees which they believe will grow in the United States. One is a tree that yields a gum base for varnish. Several other specimens produce latex, the sap from which rubber is made.

Curious Horned Nuts Look Like Buffalo Heads

A STRANGE nut shaped like the head of a water buffalo forms a rare delicacy in the diet of the Chinese, and can be purchased in various cities of this country. Prongs on either side of the shell are curved like the horns of the buffalo, while bulges and depressions on the shell's surface often give a lifelike appearance to the "face."

The resemblance to the animals is so apparent that the nuts are commonly



A handful of "water buffalo" nuts. Type of the shells form perfect horns.

[illegible]led "water buffaloes." The meat within the shells is said to be nourishing and to have a flavor highly pleasing to Oriental palates.

The World Bathes in Yankee Tubs

EIGHTEEN thousand American bathtubs traveled to all parts of the world last year. They will do their bit toward bathing citizens in sixty foreign countries, the U. S. Department of Commerce reports.

The lion's share of the $900,000 worth of tubs went to Argentina. Nearly 3,000 Argentine homes installed gleaming enameled tubs from the United States during the year. Other foreign purchasers include Cuba, Mexico, Canada, and China. Australia and Denmark bought one tub apiece—perhaps as samples.

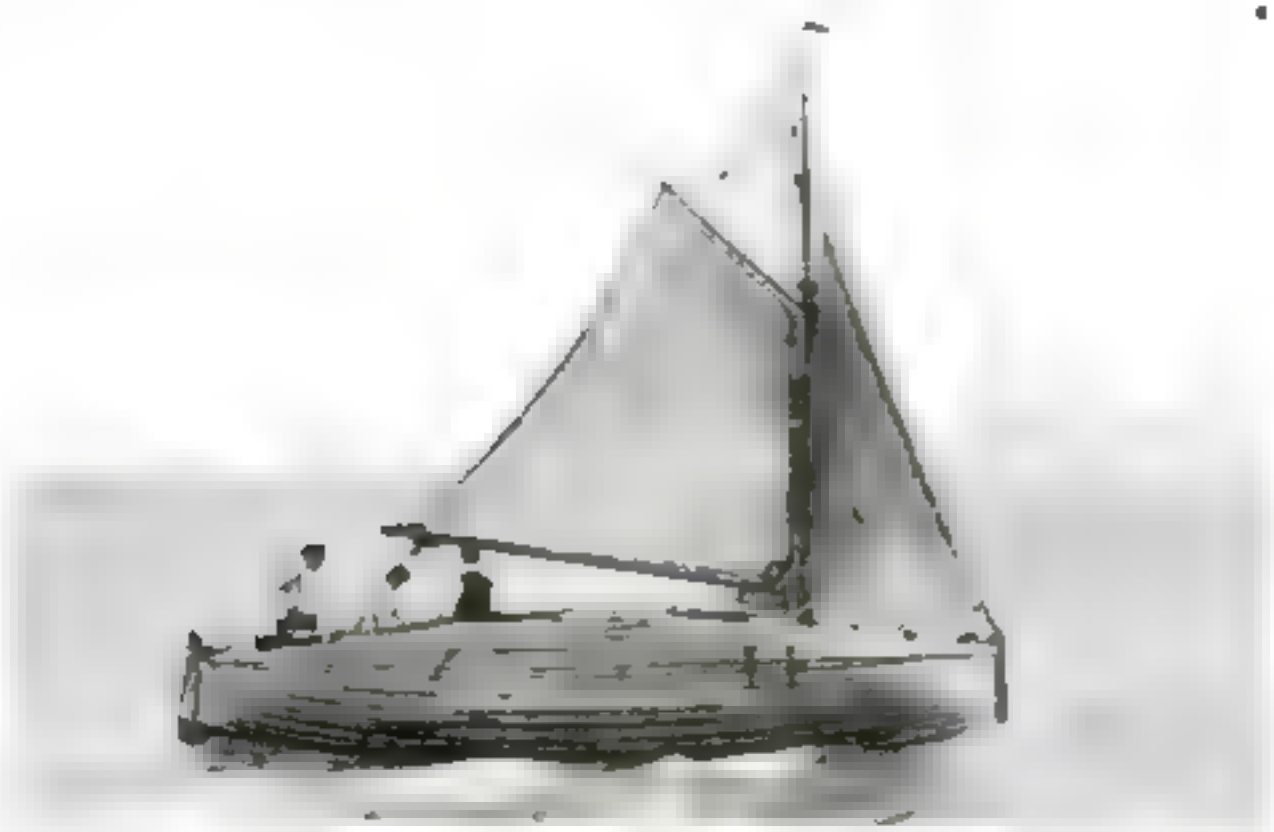
Luminous Watch Shows the Way to the Keyhole

A WATCH that illuminates the keyhole for late homecomers has been designed by a French inventor. Instead of placing luminous paint upon the hands, he has coated the dial and left the hands black so that their position can be seen against the glowing background in the dark. A key ring is attached to the watch. The dial is said to give off sufficient light to enable the right key to be selected from the ring and placed in the keyhole without undue fumbling.

Shade for Kansas

FARMS on the Kansas plains, hitherto almost devoid of trees, are now enjoying the shade of imported Chinese elms. These seem to flourish where the climate is too dry for the survival of their occidental namesakes. Botanists found that three species of Asiatic elm would grow successfully in the hot, dry summers and long, severe winters. The *Ulmus pumila*, finest of the three, attains a height of sixty feet.

Trans-Atlantic Lifeboat Rescued by Steamer



THREE men trying to cross the Atlantic in a twenty-foot boat! That is what the captain of the Spanish steamer *Marques de Comillas* found when he answered distress signals in mid-ocean one night recently. Jacob Schuttevaer, seventy-year-old Dutch sea captain, and two companions, were testing an "unsinkable" lifeboat the captain had designed by trying to sail it across the ocean. The craft, built for thirty people, had a rounded deck and hatches that could be closed in bad weather, so waves might break over its back without swamping it.

Beyond the Canary Islands, a gale ripped away the sail and mast. The boat drifted, helpless. When the three adventurers were picked up, their supply of water and food was almost gone and they had been out of sight of land for forty days. The steamer hoisted the little boat on deck and proceeded on its way to New York. Although the attempt to cross the ocean failed, Captain Schuttevaer undiscouraged, says he proved that his unsinkable lifeboat is just that!

Strange Winged Speed Boat All But Flies

A NEW type of speed boat that lifts itself clear out of the water on steel plates shaped like an airplane's wings recently attained a speed of fifty-six miles an hour at its first public test on Long Island Sound near Saugatuck, Conn., using a 240 horsepower engine only half the power the boat was designed for.

When the sport thirty-foot craft attains full speed its bottom rises until the entire weight of the cigar-shaped hull is supported on four tiny plates or "hydrofoils," with a combined area of only one and a half square feet. Somewhat the same effect is attained in stepped-bottom hydroplanes. The small area of the planes needed in the new speedster is explained by the fact that since water is many times denser than air, a small plane in water has the same lifting effect as the huge wing of an airplane in the air.

The designer, F. W. Baldwin, a naval and aeronautical engineer, claims that with a full sized engine, the craft is capable of 115 miles an hour. With it he hopes to set a new power boat speed record. The present record is 99.12 miles an hour, set a few weeks ago by Gar Wood in his speed boat *Miss America VII* at Indian Creek, Florida.

"Hydrofoil" speed boat making more than fifty miles an hour. Note the struts supporting small winglike plates or hydrofoils, which lift the cigar-shaped hull clear out of the water at full speed.

Italian Submarine Dives 383 Feet—a Record

WHEN the new Italian submarine *Maneli* rose dripping above the water of the Gulf of Spezia, south of Genoa, recently, it brought with it what is said to be a new world's record for an underwater dive. It had sunk to a depth of 383 feet below the surface, nearly forty feet beyond the previous record. The *Maneli* is an 880-ton boat with a length of 212 feet.

The new record is more than two hundred feet lower than the greatest depth at which useful work has been accomplished by a worker in a diving suit. A Spanish diver, Angel Erostarbe, descended to 182 feet in recovering $45,000 in silver bars from the wreck of the steamer *Skyro*, sunk off Cape Finisterre, Spain. In a special test two officers of the British Navy were lowered to a record depth of 210 feet, where the pressure was ninety pounds to the square inch. They were unable to perform any work, however, since deep-sea divers, even at moderate depths, lose four fifths of their efficiency due to the water pressure and the awkwardness of their heavy suits. At 210 feet they could hardly move.

Wireless Beam Will Guide Segrave's Challenger

A RADIO beam will guide a super-speed car with which Amhurst Villers, British auto racer, will attempt to set a new world's record at Daytona Beach, Fla., in 1931. According to plans he announced recently, the machine will be steered on its course with the aid of wireless beams such as are used today to guide vessels and airplanes. A white disk will appear on a dashboard indicator whenever there is the slightest deviation from the course. This precaution is made imperative by the estimated 300-mile speed of the 3,000-horsepower titan.

The world's auto speed record is held at this writing by Major H. O. D. Segrave, the famous British driver who attained 231-mile speed at Daytona Beach last March in a car aimed by rifle sights at red arc lamps strung along the course. The following month another Englishman, Capt. Malcolm Campbell, reached an average speed of 218 miles an hour, a pace equaled by no one in the world except Segrave, in a run over a bumpy South African track. He planned another attempt.

$1,000,000 in Diamonds

WEALTH in diamonds worn by Americans would make four millionaires, a recent survey revealed. The United States owns more diamonds per capita than any other country.

A Lofty Mountain Range Found Under the Sea

A SUBMARINE mountain range two miles high, which only fish have seen, was discovered recently off the coast of Chile by the nonmagnetic ship *Carnegie*. This unusual vessel, in which steel and iron have been practically eliminated, is making a three year voyage under the auspices of the Carnegie Institution, at Washington, to study ocean currents and fluctuations in the earth's magnetism liable to upset the readings of a mariner's compass.

A "deep," or valley under the sea, that dropped a mile and three quarters below the level of the ocean bed, was another discovery of the cruise. The same depth finder, sending out signals and determining the depth of the water by the time the echoes took to return from the bottom revealed the sudden descent of the floor of the sea, enabling the scientists on board the vessel to make a chart of the depression, named "Bauer Deep" after Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism at the Institution.

Sea Water by Freight for New Chicago Aquarium

A MILLION gallons of sea water transported in 145 railroad tank cars in a 1,000-mile journey from the Atlantic Ocean to Chicago, will supply the deep-sea division of the new John G. Shedd Aquarium, now nearing completion there. This aquarium not only will be the largest and most modern institution of its kind in America, but also the only one in the world not located near salt water.

The million-gallon ocean-water supply will be sufficient for several years, as it will be filtered every twenty-four hours by means of special machinery. Included in the institution's regular equipment will be a specially built railroad fish car for transporting fishes from the collecting grounds to the aquarium.

Auto Drivers Slump After Ten Years, Says Expert

IS A motorist who has driven an automobile for ten years a better driver than one who has held the wheel for only a year? No, says George A. Parker, State Registrar of Motor Vehicles in Massachusetts. Statistics, he declares, uphold his contention that veteran drivers "backslide," and after ten years or more of driving begin to lose their ability to operate a machine safely. He believes a driver's license should not be renewed each year without a new driving test.

A Safety Pyre—200 Autos Fed to the Flames

Chicago's spectacular bonfire of used automobiles, set afire by a bomb dropped from the sky.

Left: The burned machines, piled by hundreds of volunteers, as they arrived in a great procession, ready to be consumed in the fire.

WITH automobiles for fagots, a spectacular bonfire recently was ignited on the lake shore in Chicago, Ill. More than 200 machines were heaped in a great pile to form a burnt offering to safety. The used machines had been discarded by dealers as unsafe for driving, and the Chicago Automobile Trade Association staged the fire as part of a campaign to reduce the hazards of motorists on the road. After inflammable material had been packed about the cars, an airplane circling overhead dropped an igniting bomb in their midst. The leaping flames and a display of fireworks attracted large crowds of curious spectators to the demonstration.

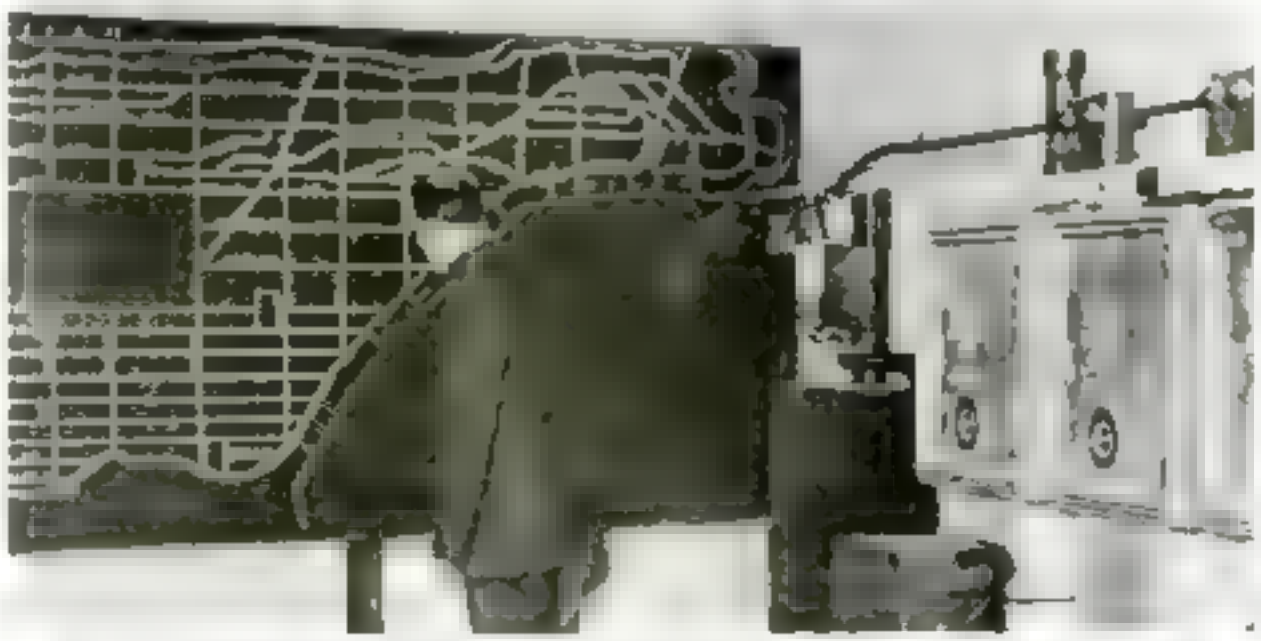
"Mechanical Brains" Rule New York Traffic

SEVEN "mechanical brains," made of copper, porcelain, and rubber, now regulate the flow of traffic on 250 miles of New York City streets. A myriad winking traffic lights at intersections flash on and off at their bidding, and taxis and limousines and motor trucks in widely scattered parts of the metropolis stop and go as they command.

A special room in a centrally located police station is the home of the robots. Governed by a master clock, they set up, at regular intervals, electrical impulses which travel over wires laid in conduits under the streets to distant traffic lights. Thus all signals in the hook-up change at precisely the same moment.

In a huge wall map every intersection light is duplicated by tiny bulbs that flash on, synchronized with the lights they represent. Thus, the officer in charge can detect the failure of any traffic signal instantly, without having to wait for a report.

The time between changes in traffic can be regulated as desired. The normal division of the time at important intersections in the city is 115 seconds for north and south traffic, and fifty-five seconds for cross-town vehicles. Extensive additions to the number of traffic lights on the thoroughfares of New York is expected to bring the total number up to 4,300 by the end of the present year.



At the right are the robots—relay boxes that automatically control hundreds of New York traffic lights. In the wall map are tiny lamps which flash on and off, revealing any failure in the system.

Handle Tightens Strings of New Tennis Racket

TWISTING the end of the handle of a new tennis racket tightens the strings for playing. Turned in the opposite direction, the handle tip loosens the catgut and allows it to "rest" between contests, thus lengthening its life

A long threaded bolt in the handle screws into the base of a metal tongue, at the throat of the racket, to which are attached all but the outer strings. When the bolt is screwed tight, it pulls down the tongue and stretches the catgut When it is unscrewed, the tongue eases its pull. The head of the bolt by which it is turned resembles the usual leather-covered handle tip In appearance the new racket resembles ordinary ones. It is the invention of J. L. Kleinman, of New York City.

Cave Men Lived in Nevada 3,000 Years Ago

KING DAVID was ruling the Israelites when implements, recently found in a cavern in Nevada, were made by an early tribe of prehistoric American Indians. This is the belief of anthropologists of the University of California, who made the discovery in a cave on the slopes of the Humboldt Mountains.

A study of the workmanship of baskets and other articles, which were kept in an almost perfect state of preservation by the dry air of the region, convinced them that the makers had inhabited North America almost 3,000 years ago. Deposits of debris and bat guano upon the bottom of the cave also testified to the age of the buried relics. In some places it was fourteen feet deep.

The cavern, known as Lovelock Cave, has been studied at intervals since 1912. Legends of the Piute Indians, living in the vicinity, tell of an ancient race known as the "Snadukes" that was exterminated in the neighborhood by their ancestors.

"Gassed" Eggs Kept Fresh by New Process

EGGS are "gassed" to keep them fresh in a new method recently announced by Cornell University, Ithaca, N Y Dr. Paul F. Sharp, professor of dairy chemistry, and A. E. Everhart, of the poultry department, discovered that carbon dioxide is contained in newly laid eggs, but that it escapes quickly through the shell. Its loss was found to be an important cause of decomposition. Tests showed that the shells would reabsorb the gas as readily as they lost it. Only a slight amount of the gas is needed to preserve the eggs.

At room temperatures, ten or twelve percent of carbon dioxide is sufficient to keep the eggs fresh, while at freezing only one percent is required. The cost of treating the eggs is said to be only a few hundredths of a cent per dozen.

Air Horn for Locomotive

COMPRESSED air from the brake system operates a novel warning horn on a new locomotive of the Lackawanna Railroad. The horn, equipped with three orifices so that the sound is directed to each side as well as to the front was especially designed to warn motorists approaching grade crossings. The big engine was designed to pull a 5,000,000-pound train at a mile a minute

Rotating Disks Measure Ripeness of Tomatoes

USING the principle of a nursery toy the familiar rotating, varicolored disks that blend into a single shade Dr John H MacGillivray, of Purdue University Indiana, has devised an apparatus to aid farmers in determining the ripeness and quality of tomatoes from their color By altering the ratio of the exposed areas of the different colored disks, he is able to produce all shades in which tomatoes appear; and, by comparison, to classify the fruit accurately as to ripeness.

The disk, spun by a small electric motor, is placed beside the fruit, and the colors altered until the exact matching shade is discovered. Fully ripe tomatoes have been found to have practically the same color, no matter from what section of the country they come. With the MacGillivray device it is hoped to establish a standard that will result in better grades of canned and fresh tomatoes being sold for public consumption.

Dr MacGillivray comparing color of tomatoes with that of the rotating disks at the left. The disks at the right are stationary

Ice Cream Gun Serves Sundaes in Cones

AN INGENIOUS new device that makes it possible to serve a fruit sundae in the shape of an ice cream cone is a "gun" which punches three wells in the cream as it is delivered into the cone. Into these holes the fruit syrup is poured. The holes are said to be deep enough to prevent spilling of the syrup as the cone is tilted while being eaten.

Because the device gives equal helpings and delivers the cream in the exact size needed to slip it into the cone, it is said to save time at a busy fountain. Its operation is simple. When pressed into ice cream, it cuts out a portion biscuit-cutter fashion. This is discharged into the cone by a pressure upon a plunger with three prongs that form the holes for the syrup.

Lampblack Prevents Fires from "Static" Sparks

LAMPBLACK, that kept housewives scouring chimneys in the days of oil lamps, has found an important new job conquering static electricity Such electricity generated by belts rubbing on pulleys, often has caused explosions and fires in dust filled factories or during threshing on farms.

Engineers of the U S. Department of Agriculture, experimenting to find a means of conducting the static electricity harmlessly along the belt, hit upon lampblack. They found that a thin layer of it, applied to the belt, prevents the electricity from accumulating in one place and dissipating itself in dangerous leaping sparks. For rubber belts, a mixture of lampblack and spar varnish, containing a nonInflammable thinner, proved satisfactory. For leather belts, liquid fish glue, glycerin, sulphonated castor oil and water were added Adding lampblack to common belt dressings was not effective. The dressing then would not stick, and electricity accumulated as before.

Submarine Rescue Pontoons Pass Crash Test

The forty-ton submarine rescue pontoon after being poised on the edge of a scaffold seventy feet above the water

A naval officer examining the pontoon after the test. Its ability to be undamaged, showing that large floats can be safely lowered from rescue ships at scene of disaster

Splash! The diving pontoon strikes the water, throwing up an enormous column of spray. One of these floats has a lifting power of eighty tons

A LIFE buoy almost as big as a whale and weighing forty tons was thrown into the ocean from a height of twenty-five feet in a recent test at the Brooklyn Navy Yard, New York. The huge pontoon for lifting sunken submarines, crashed into the water and bobbed about unmarred by its plunge. As a result of the test, the men who go down in underwater boats are promised increased protection. Instead of the necessity of towing pontoons from a distance in the event of a submarine disaster it is believed they can be carried aboard salvage ships which first go to the rescue.

One of the big problems connected with submarine salvage work has been that of bringing the pontoons to the scene of the accident. When the *S-4* sank off Provincetown, Mass., in December, 1927, the floats had to be towed from New York City. High seas were running and in the face of strong winds the tugs pulling the unwieldy floats could only crawl. One pontoon broke loose and precious time was lost reattaching the cable. For more than forty-eight hours the rescuers at Provincetown waited helplessly.

The Brooklyn test showed that the plan to carry the floats on ships is entirely feasible. Speedy vessels could dash to the scene of disaster, throw the big pontoons overboard, and begin the rescue work immediately.

When the plan was first suggested, Navy men disagreed over the ability of the heavy pontoons to withstand the impact of a drop from a ship's deck. Many officers believed they would spring a leak as a result. The demonstration was made to meet this objection. A careful examination of the float after it had plunged from its high scaffolding revealed that it had not been injured in any way.

Gar Wood, Jr., Is a Chip Off the Old Block

GAR WOOD, JR., the boy who can tell his schoolmates truthfully as well as proudly that "my father is the fastest boat-driver in the world," is not satisfied to bask in reflected glory. The twelve-year-old son of the man who recently set a new motor boat speed mark of 93.12 miles an hour, after losing a race to Major H. O. D. Segrave through an accident, bids fair to become a worthy successor to his father.

Lately, Gar, Jr., has been seen racing a small outboard motor boat, built for him by his dad, off the Miami beach. Like his father, the story of whose spectacular career was told to POPULAR SCIENCE MONTHLY last month, young Gar is an all-round sports enthusiast. Not long ago, he won the Class C model airplane contest at Miami with a machine of his own design. Gar Wood, Sr., is an aviation fan, as well, and pilots his own plane.

At twelve, Gar Wood, Jr., can run his outboard craft like a veteran. Someday, maybe, he'll beat his dad.

Sharks and 60-Foot Whale in Thrilling Battle

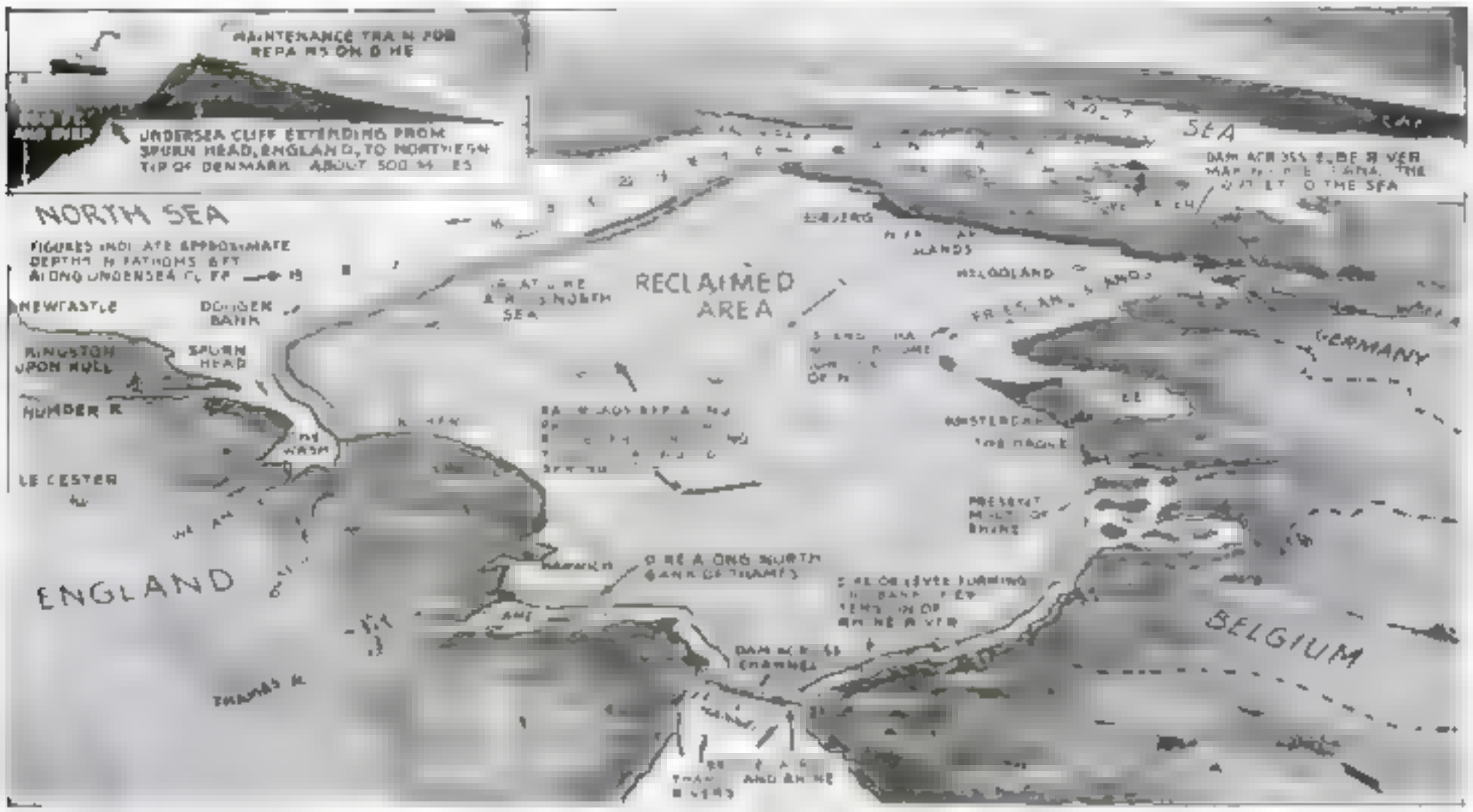
A THRILLING battle of the deep between a sixty-foot whale and two huge thresher sharks was observed recently off San Juan, Porto Rico. The sharks, of a variety that sometimes attains a length of forty feet, attacked from both sides, crashing their flail-like tails into the body of the plunging giant. At times the harassed whale would hurl its bulk almost entirely out of the water in a vain effort to escape his assailants.

For more than an hour the surface of the sea was whitened by the churning conflict. Then the three fighters suddenly disappeared. The outcome of the struggle was not determined.

Rats Attack the *R-100*

RATS attacked the British dirigible *R 100* recently as it was under construction at Howden, England. The uncompleted air liner, which is expected to make its maiden voyage to America this summer, had to be hauled from its hangar while a general rat hunt took place. Scores of rodents were killed after they had invaded the hangar and threatened to eat the fabric of the gas bags.

May Pump North Sea to Win a Rich New Land



This map shows the amazing plan for the world's biggest real estate development. A mighty 500-mile dike would be built across the North Sea from England to Denmark. The diked area then would be pumped dry

CAN the North Sea be pumped dry? More than fifty thousand square miles of it can, in the opinion of German engineers. The result is an astounding proposal to wrest from the sea an area of fertile land larger than the combined areas of Denmark, Holland, and Belgium; to colonize it, and to develop its possible mineral and oil resources.

When this enormous plan of winning farms from the sea bottom was proposed in Berlin recently, it immediately attracted the attention of engineering experts. It would restore to Europe the geography of half a million years ago. At that time, geologists believe, the ocean was much lower than it is now. England was a part of Europe in fact as well as in name. Cave men may have wandered across meadows where the English Channel now flows.

The proposal is to fling a mighty dike across the North Sea from Spurn Head, in England, to the northernmost tip of Denmark. Its base would rest on an undersea cliff that already spans the 500-mile crossing. Another dike would cut off what is now the English Channel. Then giant pumps would set about the tremendous task of pumping out the water. Since the southern two thirds of the North Sea is seldom more than 100 feet deep, it would not be long before dry land came into view.

Railroads would then replace the steamer routes of today; new cities would spring up along them. Islands in the North Sea, such as Helgoland and the Frisian Islands, would become mountains and hills in the new geography. Hamburg, Germany, now a thriving port, would become an inland city, stranded far from the sea! Dikes, thrown up like levees, would conduct the Thames, the Rhine, and the Elbe Rivers to the sea, the last through the Kiel Canal.

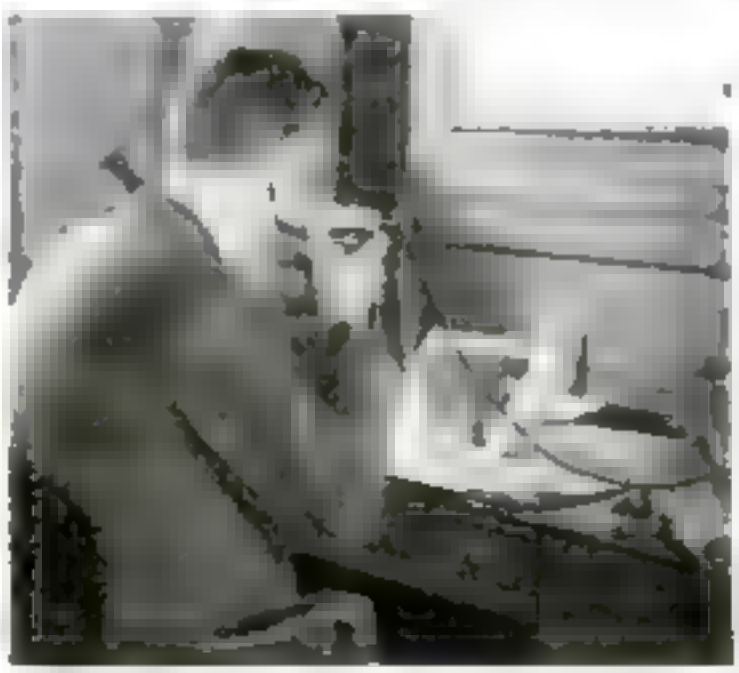
To Europe would be added a productive region capable of supporting a population of 20,000,000 or more. The new territory would probably be divided among England, Germany, Holland, Belgium, and Denmark; though puzzling questions of sovereignty might arise.

Electric Razor Needs No Blades nor Lather

SHAVING by electricity without lather is said to have been made possible by an ingenious bladeless razor invented by Jacob Schick, a colonel in the U. S. Army during the World War. The device, somewhat larger than a safety razor, can be operated from any electric outlet.

The new razor is based on a combination of shearing and nipping by the rapid vibration, at very high speed, of the inner of two parallel slotted shearing plates. The outer stationary plate is passed across the skin. The slots in the plates are just large enough to permit the entry of a hair, and just small enough to prevent the skin from being caught between the openings. The moving plate vibrates 7,200 times a minute and nips off the hair as it passes through the slots in the outer plate.

Since there are no sharp edges or moving parts in contact with the skin, the inventor claims it is impossible to cut or abrade the skin, thus eliminating irritation and discomfort which sometimes attend close and frequent shaves. No matter how hard the bladeless razor is pressed it cannot cut or injure the skin.



Shaving with the new electric razor. Just plug it into the nearest electric light socket. No lather required.

Our Food May Give Us Squirrel Chins

"STRONG-CHINNED" men and women will disappear from the earth unless the human race alters its food habits. Our descendants will be both toothless and chinless if we cling to our present diet. These are the conclusions of Dr. G. B. Palmer, British dental expert.

Food cooked to a pulp and cut into small pieces does not give our jaws and teeth the exercise they were designed to have, he says. In a few hundred thousand years, he maintains, Nature will reduce the length of the human jaw and decrease the number of teeth, until everybody will possess chins like squirrels and have no more teeth than chickens.

This Pencil Gives You a Light as You Write

WHEN the cap of a novel pencil-cigarette lighter is removed, the lead bursts into flame! It allows you to write with one end and to light your cigarette or cigar with the other.

A corrugated bit of metal on the clip which holds the pencil in the pocket rasps against a piece of flint set in the cap when the latter is removed, thus producing the spark that ignites the lighter. The combination device is about the size of an ordinary pencil, yet the maker says it holds a generous supply of igniting fluid.

Many Kinds of Precious Stones in America

RECENT reports of a black opal of fabulous value mined in Australia call to mind the fact that America has its own supply of precious stones all ready for the mining. The Australia stone weighs about an ounce and a half troy. Yet in Virginia Valley, Humboldt County, Nevada, a shimmering black opal of seventeen troy ounces was discovered.

North America can boast almost every jewel known—rubies, sapphires, emeralds, opals, turquoise, even diamonds. The last are mined in Arkansas, where a sixty-acre field produces mostly small ones.

Montana has the sapphire-producing monopoly of the United States. Rubies are found there, too, while emeralds have been unearthed in North Carolina. New Mexico finds turquoises in mines that the Indians worked two centuries ago. Maine contributes tourmaline and pink beryl, while Nevada, the opal state, owns a petrified forest where the very stone to which the trees have turned is opal.

Talking Movie Outfit for the Home

BY USING a new machine combining a phonograph, a motion picture projector, and a radio loudspeaker, you can have talking movies in your own home, according to the maker of the machine. The mechanism of the projector is geared directly to the phonograph record turntable so that their movement is synchronized, and thus the sound accompanies the showing of the action on the screen. An electric pick-up on the phonograph operates a radio loudspeaker, sound volume being governed by a button at the base of the machine. The manufacturer of the new home "talkie" outfit was one of the first to design a small motion picture projection machine for home use.

Airplane Takes Census of Alaska Game

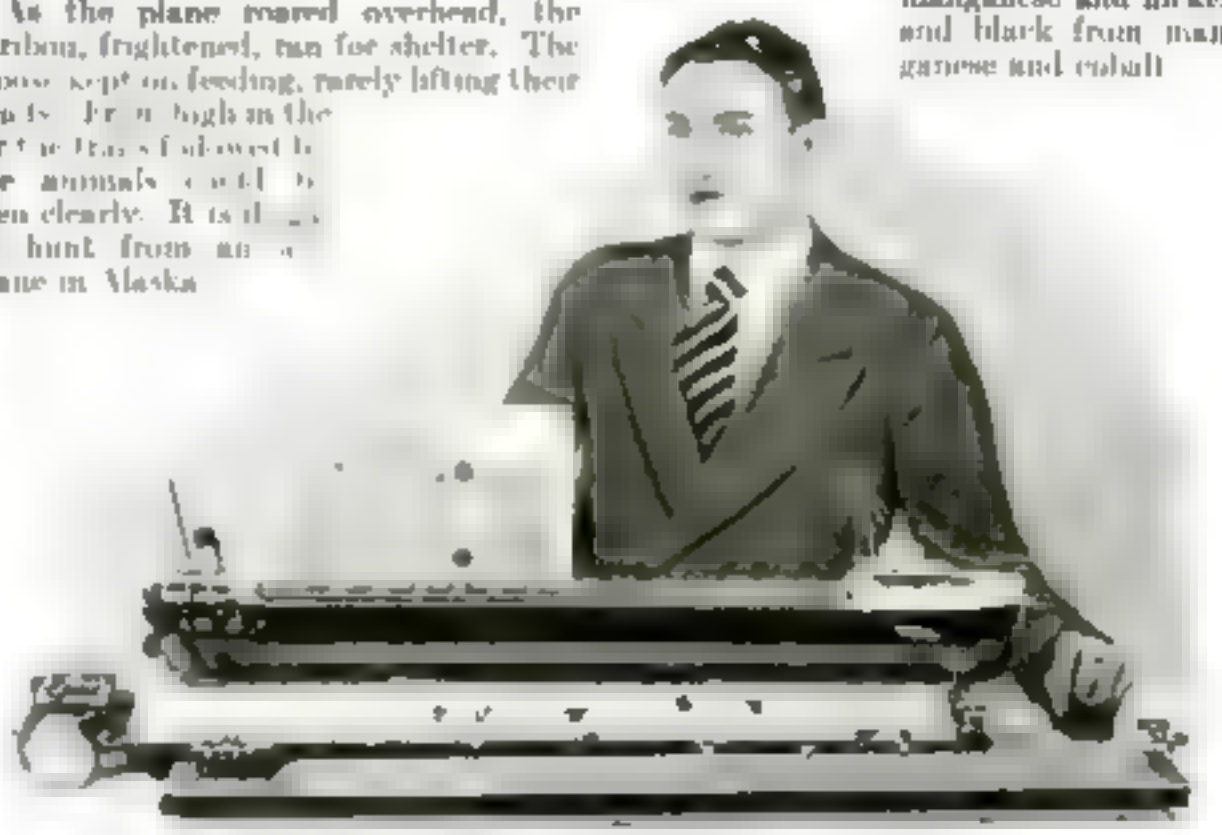
A CENSUS taken from the air of the big game animals in Alaska is being made by the Alaska Game Commission. On one flight over the Big Delta region, southeast of Fairbanks, 500 caribou and nine moose were counted. On another flight near the Tokiat River, twenty moose were sighted from the plane.

As the plane roared overhead, the caribou, frightened, ran for shelter. The moose kept on feeding, rarely lifting their heads. From high in the air the pilot found it easy to see the animals clearly. It is illegal to hunt from an airplane in Alaska.

Colored Glass Produced by Addition of Metals

THE art of glass making in this country has so progressed that Professor Alexander Silverman, head of the department of chemistry, University of Pittsburgh, and one of the world's foremost experts on glass, stated recently that fine colored glass created by American artisans now equals the product of the famous European glass factories.

The colors in the modern American glass are produced by the mixture of metals with the materials from which the glass is melted. Reds, pinks, and oranges are obtained by the addition of copper, gold, selenium, iron oxide, and manganese. Uranium, silver, and antimony furnish yellow. The greens come from iron, copper, and chromium. Blue is produced by cobalt and copper, violet by manganese and nickel, and black from manganese and cobalt.



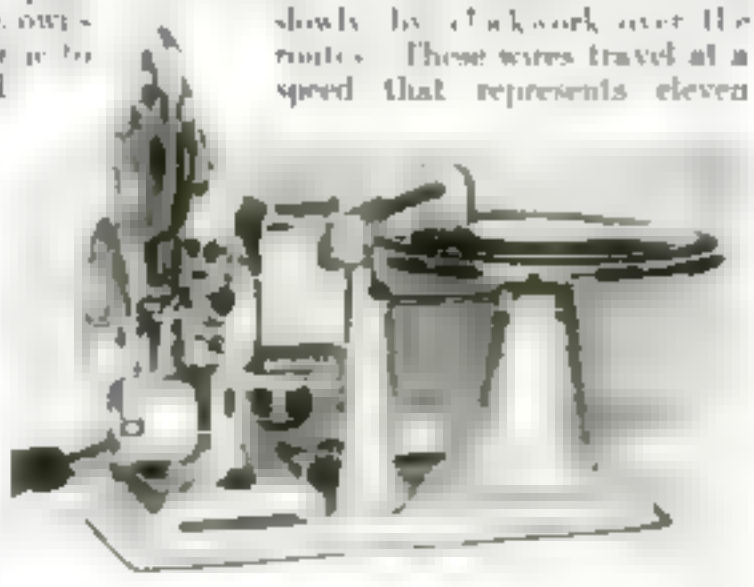
A Boy's Machine Traces Ship Movements

THE positions of steamships plying the Great Lakes are indicated at all times by an ingenious device invented by Marshall Collins, a seventeen-year-old college freshman, of Kalamazoo, Mich. He calls it the "navigometer," and it consists essentially of a chart showing the routes followed by the various vessels, and a series of wires which are moved slowly by clockwork over the routes. These wires travel at a speed that represents eleven miles an hour on the water, the average speed of the lake vessels.

Tiny saddles, each numbered to represent a certain ship, are attached to the wires and move with them, so that the position of any one of the saddles on the chart at a given moment indicates where the corresponding ship should be on the lakes. When one of the saddles arrives at a point representing a port, it touches a wire that makes an electric circuit and flashes a light on a map behind the "navigometer." If the actual ship has not reached port when the light flashes, Collins knows it has met adverse weather or has had an accident.

As soon as word is received by radio or through a maritime news dispatch that a vessel has left port, Collins places its corresponding saddle on a wire and starts it on its journey. If the ship is known to travel faster or slower than eleven miles an hour, he places the saddle representing that vessel ahead or behind the point for the start.

The device was constructed by Collins to help him in his study of navigation. In the photograph he is seen starting one of his little "ships" on its journey.



Home "talkie" machine, showing phonograph turntable with electric pick-up, combined with movie projector

How to Go Gunning for Distance

A New Bag of Tricks to Help You Reach for That Hard-to-Get Station with a One-Control Receiver

By JOHN CARR

"JOHN, I do believe you'd be tickled to death if something went wrong with that radio set, just so you'd have an excuse to tinker with it," my wife observed one evening after she'd watched me twirl the dial on our single control set.

"Oh, no," I protested. "A breakdown is the last thing I'd want. But I do wish this confounded set had a few more adjustments. In the old days, when a radio set had so many dials and switches and knobs you had to use knees and elbows as well as your hands to tune it, there was some fun fishing for distant stations. Now all I can do is turn the dial to the right wave length and sit here twiddling my thumbs waiting for the station to come in. With my old set I always hoped I'd get some adjustment that would bring in China loud enough to bounce the speaker off the table. I never did, of course, but it was a lot of fun trying."

Somehow my wife doesn't appreciate that point of view, but I'll bet the fingers of many a radio set owner itch every time he has to sit like a hump on a log and wait for the distant station to fade in.

However, when you go gunning for a certain distant station, there are a number of little tricks you can try. One or more of them may increase the sensitiveness sufficiently to put you over the top and let you log the call letters.

The modern receiver is designed to give the best average results over the entire broadcast wave band. And to obtain these desirable results, it is, of course, necessary to make some compromises between maximum sensitiveness on any given wave length, and stable, satisfactory operation over the entire band.

THE stunts you can try, therefore, include affecting the stability of the receiver temporarily in order to reach maximum sensitiveness on some one wave length, or adding another control or adjustment which would not be worth bothering with for ordinary reception. As the normal tendency of any modern receiver is to be more sensitive on the lower waves than on the upper, your chances of improving reception at the higher numbers on the dial is much better than at the lower numbers.

Assuming that your receiver is of the partly shielded type, where the tubes and perhaps the tuning condensers are exposed to view, try pulling a foot or two of the antenna lead-in into the cabinet and make a single loop of the slack wire. Then try holding this loop of wire in various positions near the detector tube and close to the detector tuning condenser. Probably you will find a position for the loop

Alexander Schaulin, Assistant Director of Popular Science Institute, testing effect of looping antenna lead-in around detector tube.

where the receiver will squeal like a stuck pig. Then if you back off a bit with the wire you will find a point where the squealing stops and sensitiveness of the receiver is greatly increased.

What happens is that you cause a radio-frequency feed back equivalent to the regeneration effect in older types of sets. You can't leave the wire in the position found to be best for the particular station on which you made the test, and then tune the set to other wave lengths. The minute you turn to a lower number on the dial the receiver will inevitably start squealing. The proceeding is useful therefore, only under special conditions on a particular wave length.

INCREASING the regeneration and consequently the sensitiveness of the circuit, may be accomplished in several other ways. For example, trying various tubes in the different radio-frequency and detector sockets may result in a combination that will make the set squeal on the low dial numbers. Such a combination will receive all stations above the squeal point on the dial more effectively than will one that makes the receiver stable on all waves.

Gummed labels attached to the tubes can be marked to indicate the position of each for either stable operation or distance getting on some particular wave length.

Increasing the B or plate voltages on the radio-frequency amplifier and detector tubes usually results in making the circuit more critical in operation and therefore more sensitive. This can be done easily with battery operated receivers by clipping the ninety-volt and forty-five-volt B wires farther along on the block of batteries. With modern electric sets this cannot be done but where a voltage adjustment permits setting the receiver for different line voltages, you can, in emergency, set the receiver for a lower voltage than the line. This steps up all the operating voltages in the receiver and may bring in a station otherwise unobtainable. Obviously, this overloads the tubes and shortens their life, but you may be willing to sacrifice something in tube life in a case, for instance, where you and your friends want to receive a special program from a hard-to-get distant station.

TUNING the antenna circuit of the average receiver may improve distant reception on the upper end of the wave band. The shorter your antenna the more improvement you will notice. To experiment with this idea, wind fifty or a hundred turns of wire on a convenient cardboard cylinder—an empty cereal box will do—and connect one end of the coil to the antenna binding post of the set. Then, by means of a needle set in the end of a wooden stick, try connecting the antenna lead wire at various points along the coil. If results warrant it, you can make up a permanent antenna tuning coil tapped at regular intervals, with the taps connected to switch points or to one of the regular inductance switches. Best results will be obtained if the antenna tuning coil is placed several feet away from the receiver so that there will be no appreciable amount of coupling to the coils in the set.

If you have a very short indoor antenna, you may find it worth while to connect the antenna directly to the grid terminal of the socket holding the first radio-frequency amplifier tube. This arrangement will work only if the receiver is fitted with a control of some kind to adjust the tuning of the first stage independently of the regular single dial tuning control.

And before you give up hope of getting the desired station, be sure to try changing grid leaks. A very high resistance grid leak, say five to seven megohms, will increase the sensitiveness of the receiver on all wave lengths. It will be found useful only on distant stations, however. With a high resistance grid leak, the detector tube quickly overloads on local stations, resulting in poor tone quality.

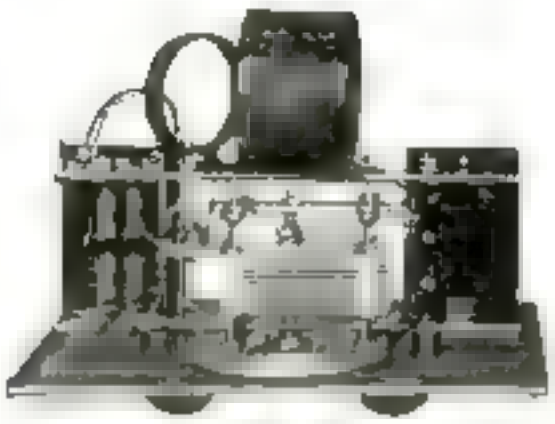


Fig. 1. Bottom view of Mr. Nebeker's prize winning set showing frame details, friction dial drive, and grid condenser

Testing competing sets for sensitiveness and selectivity in the laboratory of the Popular Science Institute of Standards.

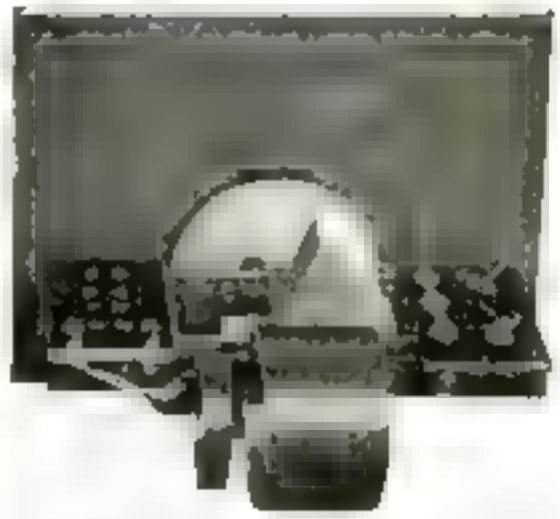


Fig. 2. First prize winning set is extremely neat in appearance. Note space wound coil in thin celluloid, mounted so that no metal parts are in magnetic field. Primary is mounted inside secondary

Prize-Winning One-Tube Sets

Announcing the Awards in Our Radio Receiver Building Contest — A Surprising Display of Skill and Ingenuity

By ALFRED P. LANE

Lyman M. Nebeker, of Washington, D. C., first prize winner

THE contest for radio set builders announced in POPULAR SCIENCE MONTHLY for March produced amazing results in the large number of entries received, and in the ingenuity and skill displayed by the contestants. In fact, officials of the Popular Science Institute of Standards, who judged the contest, report that their examination and tests of the entries were really a liberal education in how to make something out of almost nothing!

There can be no doubt that all who participated in the contest now have a much clearer understanding of the functioning of simple radio apparatus and considerably more respect for the careful engineering involved in the manufacture of factory-built radio parts.

As announced, prizes were offered for the best home-built one-tube receivers, the awards to be based on (1) operation, (2) number of home-built parts, (3) simplicity and (4) cost of construction.

The winning set was submitted by Lyman M. Nebeker, of Washington, D. C. It is shown in Figs. 1, 2, and 3. The circuit used is conventional in every respect. It

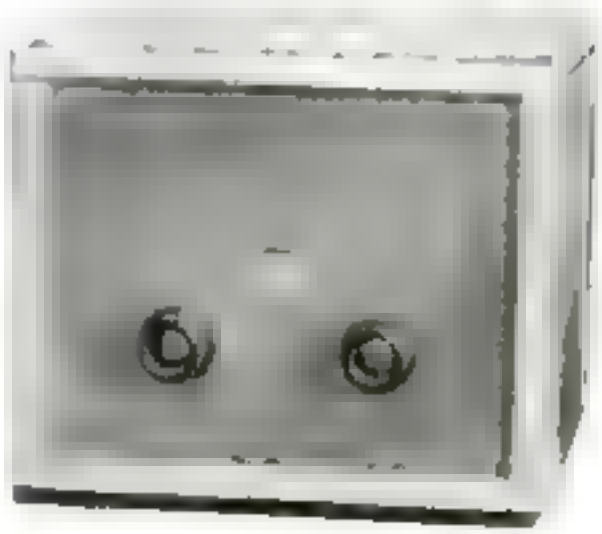


Fig. 3. The seat panel layout of the first prize set. The drawing at right shows the grid condenser on plate of the tuning condenser

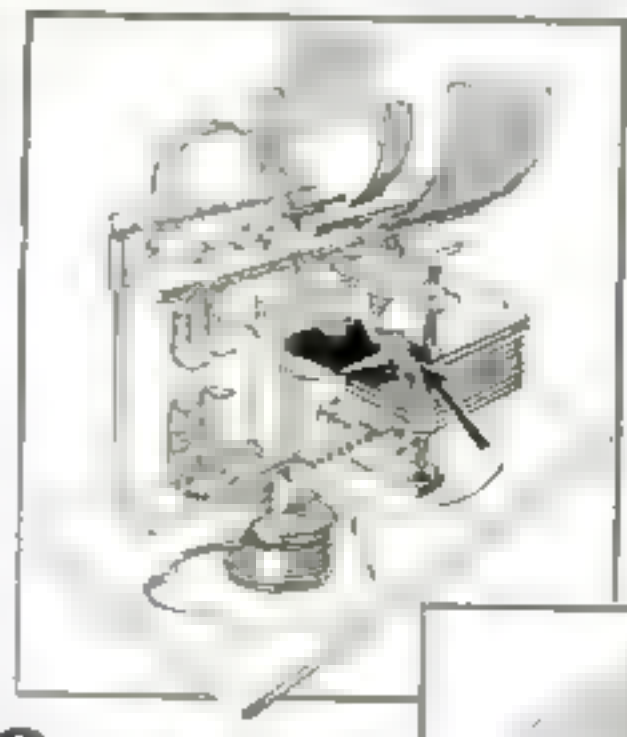


Fig. 4. Arrow at right indicates simple friction drive that operates dial of tuning condenser. A spring maintains the friction

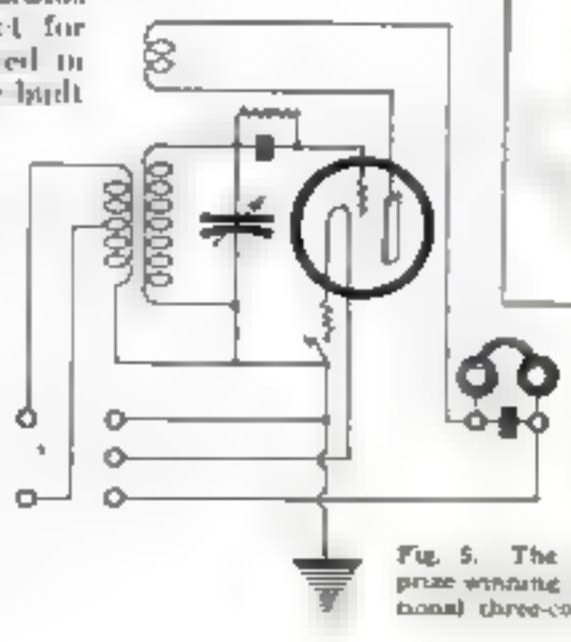
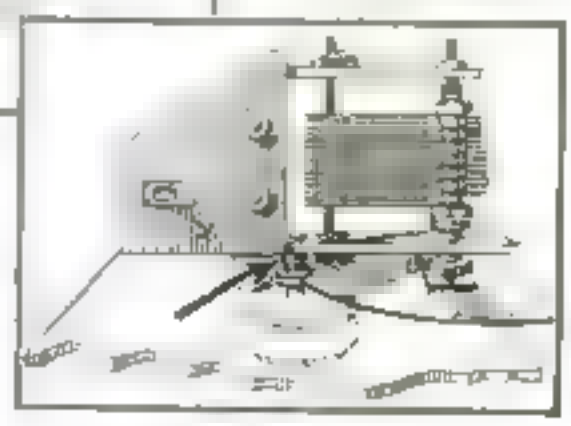


Fig. 5. The circuit of the first prize winning set is the conventional three-coil tickler hook-up

appears in Fig. 5, at bottom of the page.

Mr. Nebeker's receiver is an exceptional piece of work. Every part in it, except, of course, the screws and nuts, is home made, and yet the craftsmanship is so fine that it rivals the best commercial practice. In design, workmanship, and construction it certainly is the finest one-tube set it has ever been the writer's privilege to examine.

NATURALLY we were interested to find out what the builder looked like and also to know what training enabled him to do such excellent work. Mr. Nebeker informs us that he is in the advertising business which, of course, is a profession that does not require any manual skill in the use of tools. But other statements in his letter shed considerable light on this subject. He shuns golf, bridge, and talking movies. "My hobby," he writes, "if a condition may be so designated, is



the indulgence of a persistent curiosity and an inclination to make one screw serve where two had served before." And the ingenious way in which Mr. Nebeker has incorporated this principle into his design is responsible, in a large measure, for his success.

FIGURE 3 shows a front view of the set. The knob at left controls tuning and the one on the right controls regeneration and, in addition actuates the filament switch when the tickler coil is turned to the extreme nonregenerative position. The dial is fitted back of the panel and is made of a disk of aluminum to which is attached a hand lettered scale. The scale moves past a window cut in the panel which is made of pressed wood board with the unfinished side out. The dial opening in the panel is covered, on the side toward the cabinet with a thin sheet of transparent celluloid cemented on.

The dial is operated by a friction vernier arrangement constructed with a spring which grips the edge of the aluminum disk between two small brass disks, one of which is rigidly attached to the vernier knob shaft and the other rides on it. This method of driving the dial is shown in the photographic illustration of Fig. 1 and also in the drawing of Fig. 4. The motion is as smooth and velvety as anyone could desire.

A framework of heavy strip brass supports all parts of the set in an exceedingly rigid assembly. The handmade aluminum condenser plates are attached to four thin bakelite strips jutting out from the main frame, and the rotary plates are assembled on an axle passing through a hole in the front frame member, with an adjustable pin bearing at the rear.

A UNIQUE feature of the set, and one the writer does not recall having seen on any commercial set, is the grid condenser. If you examine any conventional radio diagram, you will note that one terminal of the grid condenser always is connected directly to the stationary plates of the tuning condenser. Mr. Nebeker has completely eliminated this connection by making one of the stationary plates of the tuning condenser extend considerably beyond the others and then he uses this extended portion as one plate of his homemade grid condenser. This is a neat, simple, and highly efficient arrangement. It is shown clearly in the illustration of Fig. 1 and the drawing of Fig. 4.

The grid leak consists of a thin strip of carbon-impregnated paper clamped to the terminals of the grid condenser.

There is no adjustable rheostat. Instead there is a fixed resistance consisting of a piece of resistance wire wound around a thin strip of bakelite.

The coils are space wound on an exceedingly thin film of celluloid so that they are practically self supporting.

Just thirty-two inches of wire were used in making all connections in the set, including the flexible wires to the tickler coil.

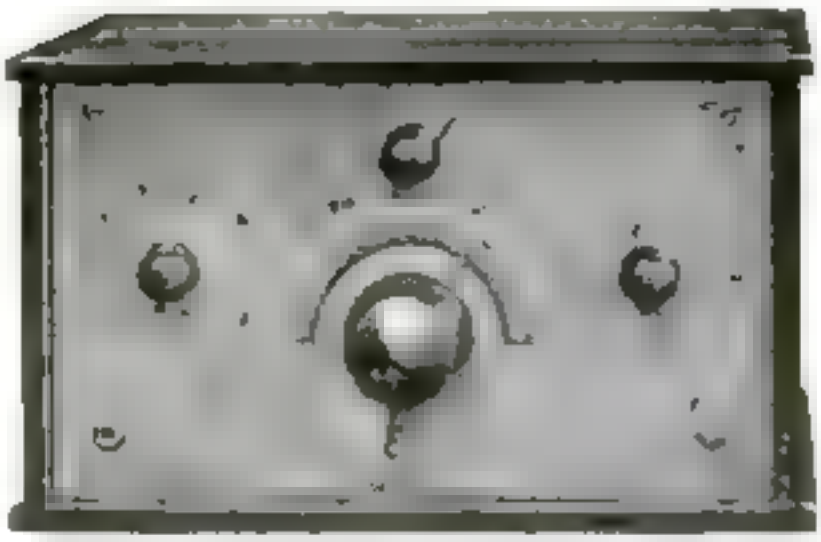


Fig. 6. Front view of remarkably fine receiver with which A. D. Zimmerman, of Blue Mound, Ill., won second prize. Tuning is controlled by the large knob. The lever operates a vernier

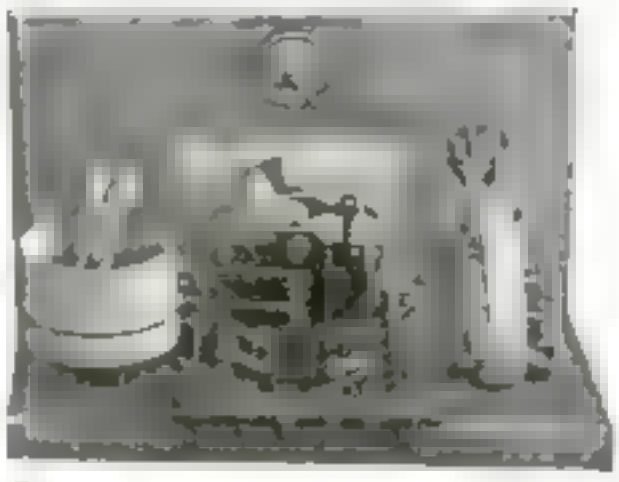


Fig. 7. The tapped, bank wound antenna loading coil is shown at the right in this rear view of receiver. Two turns couple it to the secondary.

Taken all in all, Mr. Nebeker's set is a beautiful example of carefully thought out design and exceedingly clever workmanship. The judges agree that he has fairly won the first prize of $25.

The second prize is awarded to A. D. Zimmerman, of Blue Mound, Illinois. His receiver, shown in Figs. 6 and 7, also is a very fine example of a home-built set.

The tuning condenser is rebuilt from an old condenser taken from the scrap pile. All knobs are homemade and the dial, over which the indicator attached to the tuning knob moves, is made from a hand-lettered circular piece of paper. Indicating figures on the panel are carefully lettered in pencil and the whole shellacked to keep them from rubbing off or becoming soiled. The panel is a piece of ply wood. A vernier plate has been built into the tuning condenser which is operated by a lever projecting below the large tuning knob.

Mr. Zimmerman has built practically all of the parts with the exception of the tuning condenser above noted and the resistance element of the rheostat which, he states, was taken from a broken one he had. Both the push-pull filament switch and the output phone jack are entirely homemade.

The electrical circuit of Mr. Zimmerman's receiver is essentially the same as is detailed in Fig. 5, except that he has incorporated a method of tuning the antenna circuit. At the left of Fig. 7, the back view of the set, you will note a coil mounted edgewise with a number of taps which are connected to a homemade inductance switch mounted on the panel. A two-turn coil is wound around the secondary coil of the detector circuit, and by means of the inductance switch it is possible to connect this two-turn coil with a progressively larger and larger portion of the bank-wound loading coil shown at the right.

ELECTRICALLY, Mr. Zimmerman's set tested up a shade better than any other receiver in the contest, but not quite enough to overcome the superiority of Mr. Nebeker's set on the other three points which counted equally in the contest. We wish to congratulate Mr. Zimmerman on his excellent showing in the contest. A check for the second prize of $10 has been mailed to him.

The third prize of $5 is awarded to Maxwell Harding, of Kalamazoo, Mich. A rear view of his set is shown in Fig. 8. It is an outstanding example of what can be done with the cheapest possible material and almost no tools with which to do the work.

Tuning is accomplished by means of a book-type condenser consisting of two plates made from a piece of sheet zinc. One plate is fixed and the other is hinged so that it closes against the fixed plate like a book. A couple of brass gears that once did duty in an alarm clock are arranged to form a vernier motion to operate the sheet zinc cam that moves the condenser plate. A rubber band supplies the pull to keep the plate against the cam. A condenser of this type, unless very accurately constructed, has a limited capacity range so that it is necessary to use a tapped tuning coil to cover the broadcast band of wave lengths.

MR. HARDING has wound his coil on a round cardboard cereal box and he has provided the necessary number of taps together with a couple of extra fixed condensers to extend the range of the tuning condenser.

Mr. Harding should be proud of his showing in such a stiff competition.

The judges have awarded honorable mention to the following contestants: John C. Arnold, Jr., Burlington, Vt.; Cleon M. Bliss, Ann Arbor, Mich.; Alberto Ceballos, Winslow, Arizona; Adelbert Clark, Healdsburg, Calif.; Elmer Davidson, Holbrook, Neb.; Tom Feaster, Shinnston, W. Va.; Nathan L. Hall, Jr., Elkins, W. Va.; Aaron A. D. Jensen, Iowa City, Iowa; Joseph Kalopus, Elyria, Ohio; Herbert Mills, Owensboro, Ky.; Paul F. Mitchell, Marlboro, Mass.; P. L. Morgan, Lynchburg, Va.; Neal Plourde, River Rouge, Mich.; Leslie R. Sanderson, Emo, Ontario, Canada; John R. Sargent, Philadelphia, Pa.; Harold Smith, Burlington, Vt.; N. B. Wales, Jr., Brooklyn, N. Y.

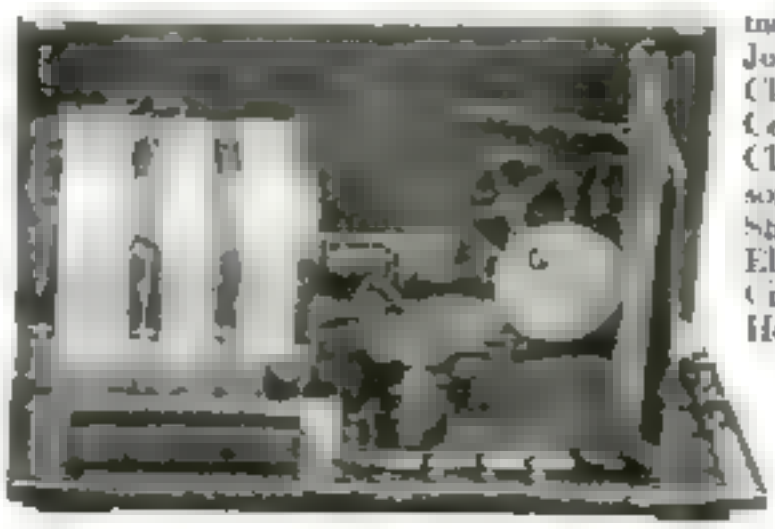


Fig. 8. Maxwell Harding, Kalamazoo, Mich., won third prize with this receiver. Note book-type tuning condenser.

Radio Ideas Novel and Useful

Water Pipes for Your Antenna

A Surprising New Trick to Bring in Signals on an Electric Receiver—Facts About Hum and Its Cure

MODERN self-contained electric radio receivers are simple to install. Merely plug the cord into the nearest light socket and hook on the loudspeaker. As far as the set itself is concerned, the installation then is complete, but there still remains the problem of the antenna. And this problem is not a simple one, because the requirements vary with the owner, while the possibilities for reception vary with the locality.

You may want only the local stations with good volume. Another man may want distant stations. You may have ideal facilities for stringing an outdoor antenna, such as a tall tree at a convenient distance from the house. But another man living in an apartment house where antennas on the roof are barred, must start at the beginning and try first one method of bringing in the signals and then another until he strikes one that gives desired results.

The illustration on this page shows the simplest possible way to bring in signals with a modern electric set. Run a wire from the nearest water pipe or radiator to the antenna binding post of the set. Leave the ground binding post unconnected.

CURIOUSLY enough, in many cases this simple arrangement will give results as good as can be obtained from a light socket antenna in the same location. In fact it operates as a simple form of light socket antenna. The signals being picked up on the light wires enter your receiver by the back door, so to speak. They come in through the electrical capacity of the primary winding of the power transformer, which is insulated from the secondary of the instrument, and leave your set through the antenna connection to the ground.

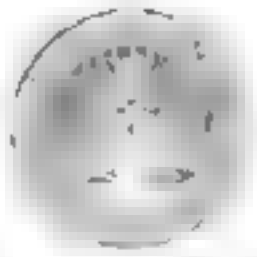
It is never possible to predict the results obtainable by this connection, but it is worth trying. If it doesn't work, then try a regular light socket antenna as the next scheme on your list. Here, too, you cannot predict results, which depend on the arrangement of the wiring in the house.

If neither of these methods gives adequate signal strength, then see what you can do with an indoor antenna. The cheapest kind of bell wire or even wire stripped from the magnets of an old bell will do as well as the most elaborate special wire. The best indoor antenna is one that is longest, *measured in a straight line*, from antenna binding post to the far end. Obviously, the longer the indoor antenna and the higher

A wire run from nearest water pipe or radiator to the antenna binding post serves as antenna. Leave ground post unconnected.

the far end, the better will be the results.

The indoor antenna does not necessarily bring in signals. In these days of steel frame buildings and metal lath work, it may be so thoroughly shielded that it cannot bring in anything. As a last resort, you will be forced to put up an outdoor antenna, the higher and longer the better. Don't waste time or money on the so-called buried antennas. They work no better than the simple grounded antenna post method already mentioned.



A B C's of Radio

THERE are two types of radio wiring diagrams. One, the theoretical wiring diagram, uses symbols to represent the various parts of the circuit. The other, called the "picture" diagram, substitutes pictures of the various parts as they actually appear.

Once you understand the symbols, it is easier and simpler to work from a theoretical diagram, and there is less chance of making mistakes. A variable condenser, for example, is represented by two parallel lines with an arrow drawn diagonally through them. If one line is curved, it represents the moving plates of the condenser. Thus there never is any question as to how the wires are connected to it. This simplicity is even more evident in the representation of coils. You cannot mistake the connections to a coil symbol, which is simply a line drawn in a series of small loops or curls.

Curing the Hum

IT FREQUENTLY happens that when two identical radio receivers are installed in different homes, one of them will produce more hum than the other. Often the cause of the hum is obscure, but frequently it can be traced to differences in the tubes used in the two receivers. Occasionally a detector tube, although electrically perfect in other respects, will produce an undue amount of hum because of some peculiarity in the construction of the elements. It is well, therefore, to try another tube in the detector socket before you condemn the set.

A poor ground connection also will produce a severe hum in some cases. And it must be remembered that all broadcasting stations are not perfect. Some of them radiate considerable hum in their carrier wave. If, for instance, you notice a bad hum when you tune in a particular station, and the hum is much less or completely absent when you tune in a different station, it is certain that the first station is to blame, not your set.

Another peculiar hum, really an illusion, is one that seems to appear late at night. You may not notice any hum in the early evening, for example, and then notice a decided hum late at night just before you turn off the set. What happens is that during the early evening, your ears hear so many miscellaneous noises that they are, relatively speaking, insensitive to weak sounds. Later in the evening, when street noises and other distractions subside, your ears regain their sensitiveness and the hum appears more pronounced.

Hum and Speaker Quality

IF YOU test several different loudspeakers on the same set under exactly the same conditions, the speaker which reproduces the hum most clearly and loudly is the best for low note reproduction. The only exception to this rule is the hum produced by alternating current operated dynamic cone speakers where the hum is introduced by the speaker.

In general, the more perfect a radio receiver is in its ability to produce the low notes, the harder it is to make it absolutely hum free.

Choosing the Best Roof

By ROGER B. WHITMAN

This roof, made of copper coated asphalt shingles, gives the attractive effect of thatch.

"NOW that you have settled on the kind of walls you want," said the architect, "the next thing is the roof. Have you any ideas about it?"

The Kerseys, deep in plans for their new suburban home, were spending their second evening in consultation with an expert architect. In their first talk with him they had shown him the design for the house they had in mind and had received valuable advice on foundation and walls. Under his guidance they were learning much about materials and methods.

"We saw such a pretty roof over at Wiladon the other day," said Mrs. Kersey. "It was in different shades of brown, and uneven and rough."

"What was it made of?" asked the architect.

"Why—I didn't notice. I was so taken with its looks I didn't think of anything else."

"The appearance of a roof is important, of course," said their mentor; "but don't forget that it is the hardest-worked part of the house, what with being soaked with rain and baked out by a blazing sun, and getting the pounding of sleet storms in winter. Weather never should make it leak, and it shouldn't suffer from age. If it isn't fireproof, it should burn so slowly that the firemen will have time to check the flames before much damage is done. Besides that, the roof should be heat-proofed. If it isn't, you'll be burning coal to melt the snow on it, and in summer the attic will be too hot to use. Make your roof a good one all the way through. You'll never regret the money you spend on it."

"I NEVER thought of a roof as having insides," said Mr. Kersey. "How is one built, anyway?"

"Come up into my attic and I'll show you," responded the architect, and up they went.

"These rafters," he explained, "hold up the roof and give it shape. These are two-by-sixes. I never use anything smaller, and usually two-by-eighths. With copper shingles on the outside this roof isn't heavy, so two-by-sixes will do, but for a big house roofed with thick slate or heavy tile they'd have to be still larger, and braced at that. See these boards between them? That's the sheathing seven-eighths-inch tongue-and-groove, and covered with asphalt building paper. That under part of the roof is water- and wind-proof, and the shingles protect it from the weather. The nails are copper, too. That roof will last a good deal longer than I will."

"It looks fine," said Mr. Kersey. "It's different from one I saw yesterday, made of wood shingles without sheathing. The shingles are nailed on strips of wood laid across the rafters, and they show from the attic. There are only three layers of shingles between the attic and outdoors, and it didn't look very solid."

"That's the way many wood shingle roofs are made, and on good houses, too," answered the architect. "It isn't only because people are saving money either. Many builders believe that wood shingles must have open air under them to keep them dried out and to prevent rotting, although that kind of roof won't hold heat and will burn through in a hurry if it catches fire. It has never struck me as being good construction."

"Don't you like wood shingles?" asked Mrs. Kersey.

Rough-edge asbestos shingles in variegated color give a pleasing effect of irregularity

"WHEN they are the right kind of wood, I do. Coastal red cypress and redwood shingles are fine, and so is creosoted red cedar. But I have no use for shingles of second-grade wood and sawn so thin you can almost see through them."

"But even with good shingles the roof won't last if it isn't made right. A friend of mine bought a house a couple of years ago, and last week he asked me to tell him why the shingles were coming off. I found the shingles had been put on with bare wire nails. Two years of exposure had rusted them away and the roof was going to pieces with every gust of wind. If the nails had been rustproof the roof would have lasted fifteen years. A thing like that won't happen to the roof that I'll put on your house, but you'll have to tell me what you want it made of. I suggest you go to that exhibition of building materials that opened in town last week, you'll find many kinds of roofings there, and it may help you to make up your minds."

There is richness in a roof of burned clay tile. Notice the taper of the tiles on the turret

THIS they did, and found exhibits of slate in thin sheets and thick slabs, rough and smooth wood shingles in all colors, flat and curved tiles of burned clay, cement and metal, asphalt shingles surfaced with crushed slate and with copper, and asbestos shingles of all kinds and colors, from thin and smooth to thick and irregular. The Kerseys asked an attendant to explain the points of each.

"The lowest price roof you can get," said he, "is bare wood shingles laid without sheathing, but in ten or twelve years

ordinary shingles will be so warped that the job will have to be done over. Soaking the shingles in creosote will keep them flat, and the roof will last twice as long but it'll cost more in the first place, and you'll have to restain every few years. But even at that, wood shingle roofs are the most popular there are, some house designs require a roof of wood shingles.

"Slate is another old-time roofing material, and so is this burned clay tile. The tile is heavy, and the roof frame must be stout to support it, but it is like slate in being permanent.

At right: A fireproof and weatherproof roof of tapered rough asbestos-cement shingles. Also, an excellent example of valley flashing.

When a new roof is needed it is well to lay new shingles over old. Those shingles are asbestos on wood.

"THAT panel over there is sheet copper, and the next is copper formed into shingles. They are permanent, too, and they make about as lightweight a roof as you can get. The weather takes off the bright color, and they turn attractive shades of green.

"The rest of the panels are manufactured materials. These are asbestos, Portland cement mixed with asbestos fibers. They are hard and rigid, weatherproof and fireproof."

"Why are some of them laid straight and some diagonally?" asked Mr Kersey.

"There is a difference in cost," answered the attendant. "When shingles are laid straight, each one covers more than half of the one below and is more than half covered by the one on top, so that the roof is three shingles thick. The shingles themselves are much longer than they are wide. Shingles that are laid diagonally are square, and overlap each other by only an inch or so. Except for that inch the roof is only one shingle thick. That saves material, but for a tight roof there must be good sheathing and building felt, and the shingles must be so flat and smooth that rain can't get through the joints.

"Here are asphalt shingles; they're flexible, you see. They are made of coarse felt soaked with asphalt and covered with it on both sides, and the top is finished with crushed slate or some other kind of stone. Those over there are plated with copper. They are waterproof, and last a long time.

"THEY come in all colors, and the cost is about the same as wood shingles. They are made as separate shingles, or in strips that cut the cost of laying."

"If you were building a house, what would you use for the roof?" asked Mr Kersey.

"With plenty of money and an elaborate design," the attendant replied, "I'd probably use hand-made burned clay tile or thick slate slabs. For a more moderate Colonial house I might use wood shingles split instead of sawn, or stained sawn shingles. If the design called for a roof of thatch effect I'd have to use something that could be bent to the curves of the eaves and the valleys—sawn wood shingles or specially made asphalt."

"Hold on a minute," said Mr Kersey. "What do you mean by 'valley'?"

"That is the crease where the roof of an extension meets the main roof. It is made tight by the flashing."

"Flashing? What is that?"

"IT'S the name for the sheet metal that waterproofs the joints of a roof, around a chimney or a dormer, or where two roof sections meet," the attendant explained. "There must be flashings wherever there isn't roofing, or there'll be trouble, and I wouldn't use anything for flashings but a metal that won't rust. It's cheaper in the long run."

Here was a fund of information that the Kerseys digested as they went home, and that they applied on visits they made to all of the houses under construction or repair in their neighborhood. One was a frame house with a leaky bare wood shingle roof that was being covered with some other material the Kerseys could not identify. They inquired of a grizzled old carpenter at work on the job, and learned that a new roof was being put on over the old one.

"Time was," said the carpenter, "when we used to rip off the old shingles on a re-roofing job, and it made a terrible mess. Now we know better, and save time and money. It makes a stronger roof, too, and the double thickness keeps the house warmer in the winter."

"WHAT do you use for the new roof?" asked Mr. Kersey.

"This is asbestos, but you can use copper shingles, wood shingles, or asphalt. The old roof is the foundation, the new one simply turns the weather. I like stiff shingles, myself; but you can use asphalt shingles if they're the kind that lock together so the wind can't get under 'em. This new roof, though, wouldn't have been needed if the owner had spent a little more for a decent roof in the first place. It began to leak less than four years after it had been put on."

That evening the Kerseys called again on the architect.

"Well, what do you know about roofs?" he asked. "Have you made up your minds?"

"What do I know about roofs?" responded Mr Kersey. "I know so much that I'm no more able to decide what we want than I was in the beginning. It's up to you to set us right. What do you think about it?"

"Putting it that way, I'll tell you. Your house design calls for an informal roof, something in rough and uneven wood shingles, stained gray. But the house next door will be only thirty-five feet away, and it's a ramshackle place that'll go like tinder if it ever catches fire. That being so, your roof should be fireproof, and I recommend those rough asbestos shingles you saw at the show.

"THEY'LL give the same effect as the others, and while they'll cost more, you'll save in the end because the color is permanent. How does that strike you?"

"O.K. with me," responded Mr Kersey, and with Mrs. Kersey's agreement they turned their attention to the parts of the house about which they thought they knew something, the interior walls and finish. What they learned about this interesting subject will be told in another article next month.

Courtesy The Home Guild of America, Architects

THIS is the design chosen by the Kerseys for the house they plan to build. If you were in their place, what kind of a roof would you select for beauty and durability? In this article an expert gives valuable suggestions on the whole question of roof construction. What is your problem? The Popular Science Institute will help you solve it. Simply write to Building Service, Popular Science Institute, 250 Fourth Avenue, New York.

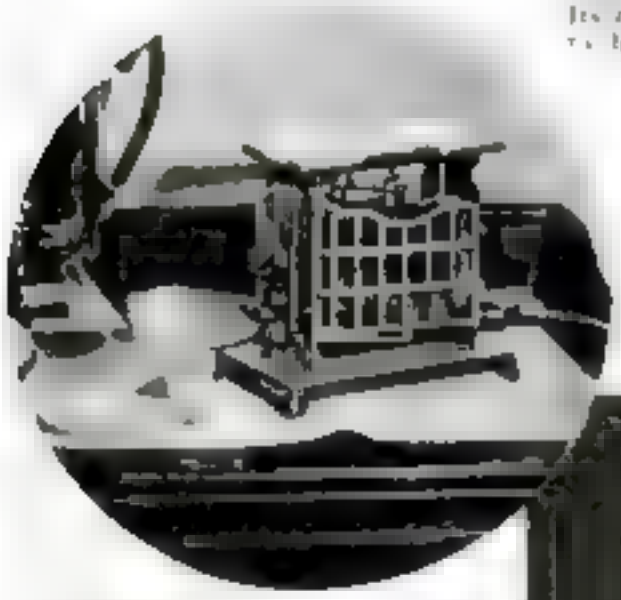
Novel Household Inventions

An invention that overcomes the bulky disadvantage of the step ladder. Utilizing the same principle as found in high furniture and wall cupboards. Pulled out the shelf is a support at convenient height for ironing board

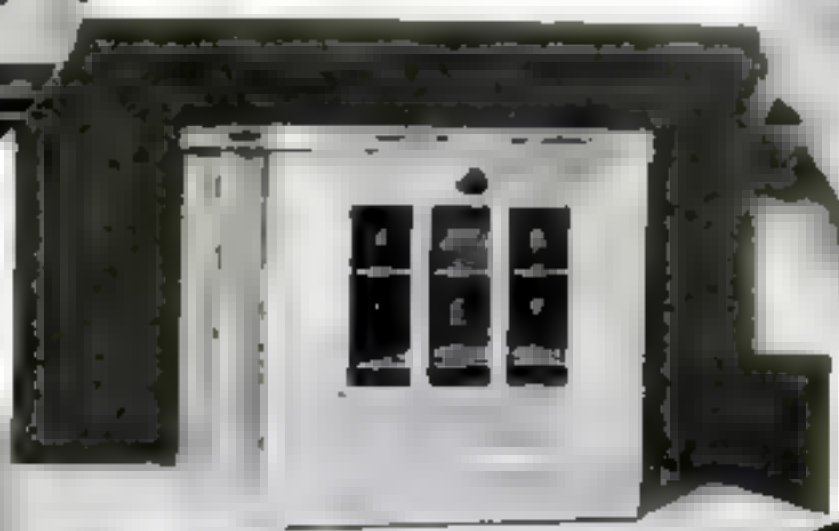
Navigating right for the bridge table is supplied by a new ashtray lamp that stands on a pedestal beside the players. Its 100 watt bulb throws full light to the playing surface while a reflector shields the table

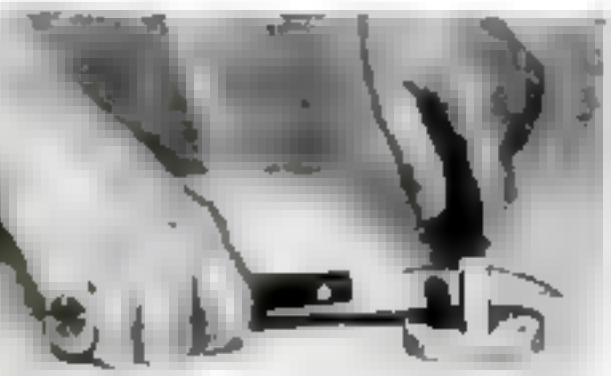
This gadget, shown actual size, is a portable pipe cleaner. Inside a metal tube is a coil spring with a wire brush at each end. Pulling the coil in and out cleans the pipe

One of the new automatic novelties is a table grill that turns itself on at any desired time and then shuts itself off. Simply turn the dial to the desired time



Press the button and the toast turns over. Here is a convenience that saves scorching your fingers. There are two buttons, one for each of two slices that are toasted at once



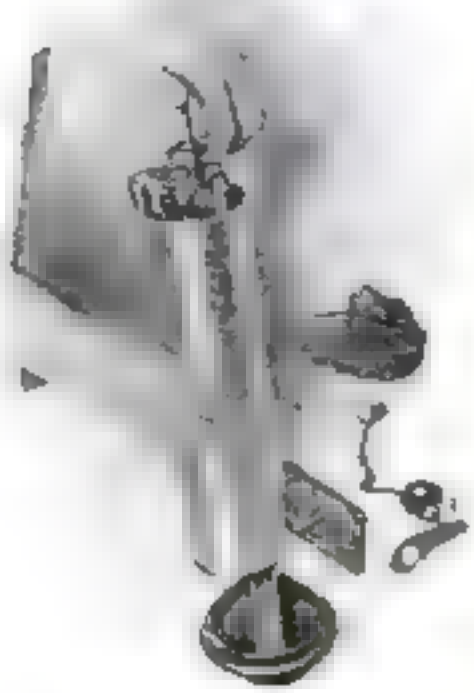


A new type of knife sharpener with adjustable sharpening stones. The aluminum base has a handle and also screw holes so that it may be fastened to a table top

A bake oven that fits over your electric table stove and folds to a thickness of only an inch and a half when not in use is designed especially for kitchenettes. Either of its two shelves has room for a small roast or batch of biscuits

Convenient molded dinner plates of hard wood pulp fiber are designed to solve the dishwashing problem. Use them once and throw them away. With them is supplied a handy tray for serving

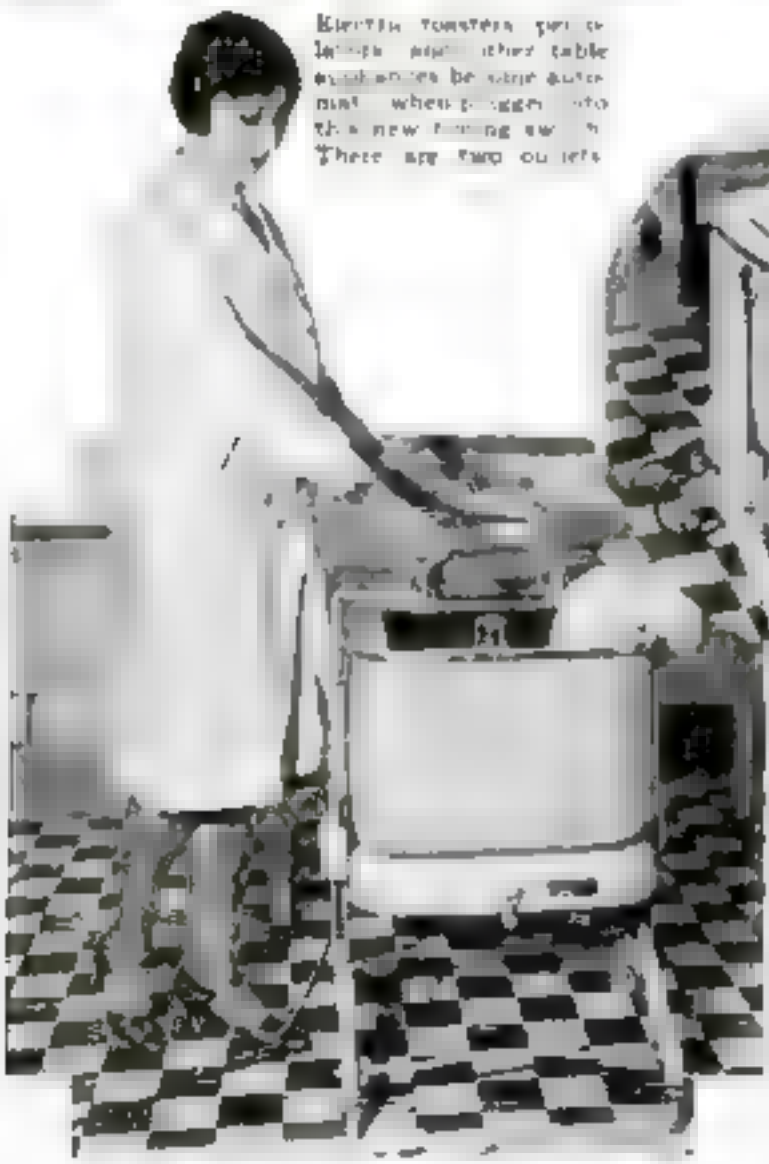
The bake oven folded flat and held with a strap. It is made of aluminum and fiber with mica windows, and can be set up in a few minutes without bolts or rods



A new drain and sink cleaner operated like a tire pump. Air pressure of thirty to eighty pounds to the square inch blows the clogged pipes clear

Unfold one leg of this new bridge table, and the other legs open automatically. The motion is transmitted from one to the others by a sliding ring beneath the table top.

This miniature twelve-pound sewing machine, weighing little more than a portable typewriter can be carried most anywhere and used even on a card table. Its electric motor hidden in the base plugs into any wall socket. A foot control is included.



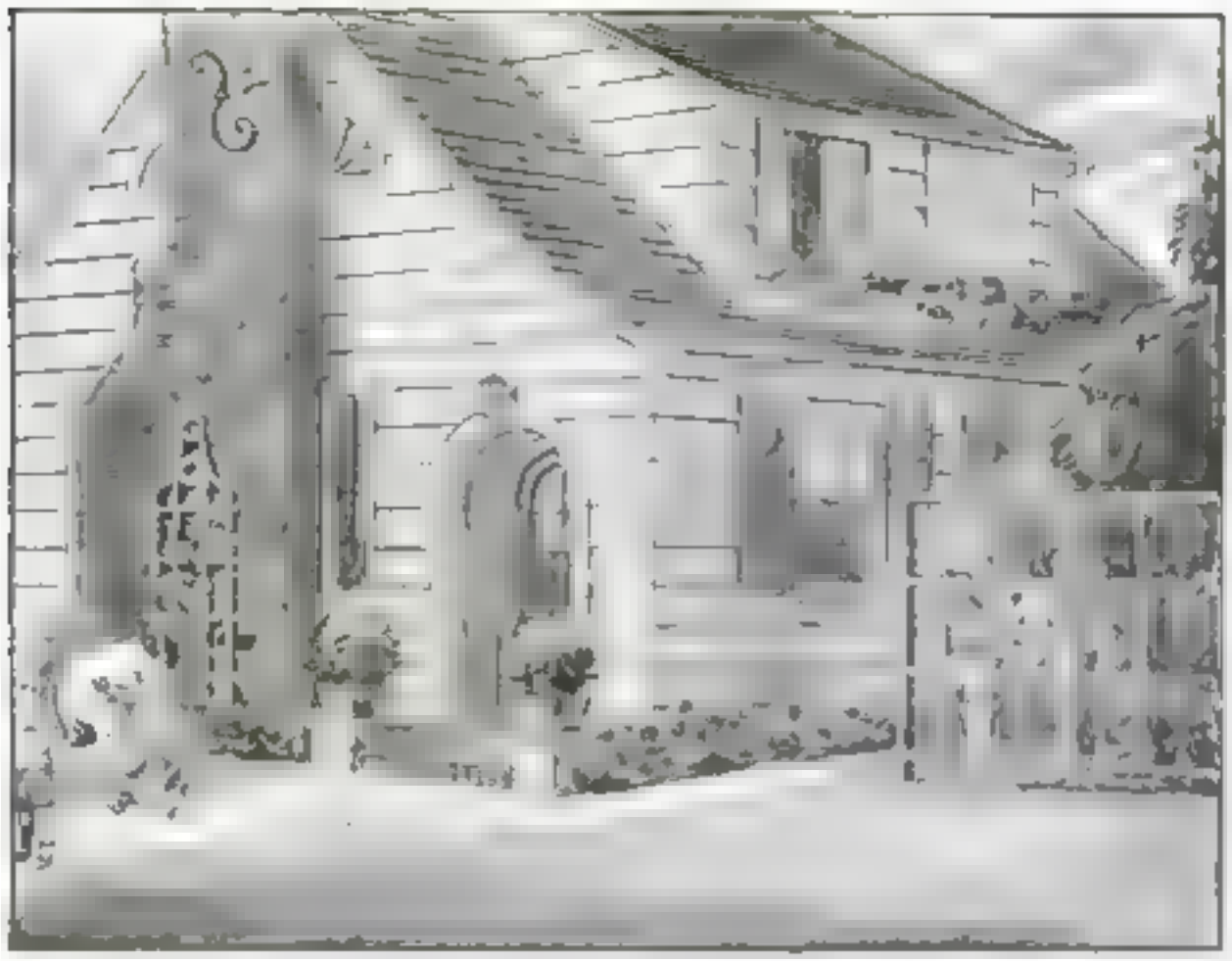
Electric toasters, percolators, and other table appliances be operated when plugged into this new turning socket. There are two outlets

Now one can get the electric washer whose speed can be regulated to suit the wash. A convenient control switch on the frame not only sets the machine humming at any one of twelve speeds, slow or fast, silks and organdies to heavy woolens, but reverses the motion every few seconds to prevent tangling. This photograph shows how the rotating switch is operated.

Turning a crank on the side of this novel washer makes it go up or down like an elevator, high enough to reach without stooping or low enough to tuck away under a table after use as shown in the picture. When the washing is done the wringer at the back folds down, or can be removed.

A tablespoonful of salt and half a pint of vinegar in this glass cheese container are said to keep the cheese fresh. Projections in the bottom of the jar hold the cheese dish clear of the solution.

Adjusting the heat of your electric iron to the right temperature for fine silks or other goods that might be scorched by full heat is possible with a new device inserted between the plug and the socket of the iron.



Well-designed trellises and fences and adequate planting enhance the beauty of any house, whether the architecture itself is plain or ornate.

Trellises Improve the Garden

And You Can Build an Unlimited Variety of Them at Trifling Expense —Ornamental Fences Also Add to the Attractiveness of the Home Grounds

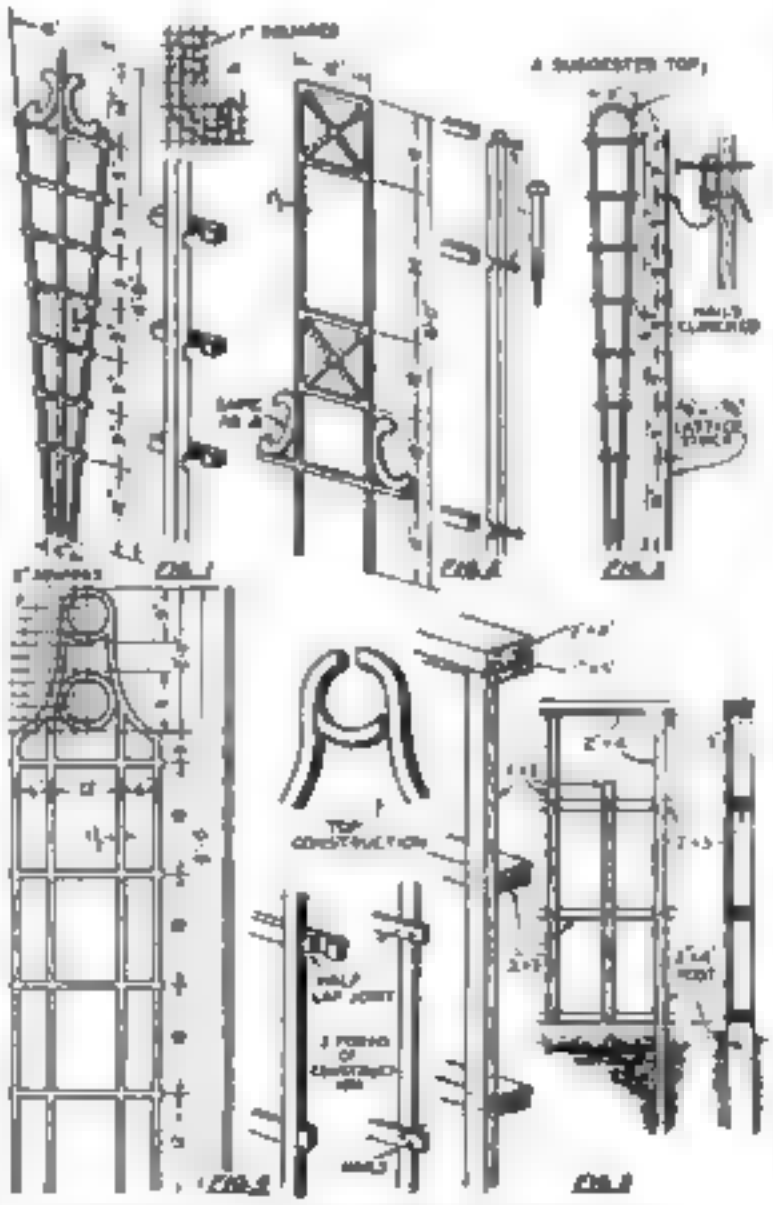
By

F. CLARKE HUGHES

TRELLISES and fences in an infinite variety may be made by any handy man or boy. And the most artistic are often the least expensive to construct, because their beauty lies in their proportions and design, their simplicity and appropriateness, rather than their size and elaboration. Indeed if the work is planned early enough, many odd bits of excellent materials may be salvaged from the kindling pile or may be obtained from the waste and cuttings about a new building.

Nothing adds so much to the general appearance of the average garden or lawn as a well-designed trellis or a small fence. Artificial supports are always pleasing if carefully planned and wisely placed, and a clean white fence gives an air of seclusion wherever that is desirable on account of unattractive surroundings. In the small home garden where space is at a premium, the trellis or fence should serve at least two purposes—a support for climbing vines and tall shrubs and a useful screen for some portion of the garden.

Materials best suited for this work are pine, cypress, western cedar, and fir, however, any wood that will withstand the sun and rain without checking too much or twisting out of shape will serve the purpose.



Designs offered by Mr. Hughes as suggestions for home craftsmen. These can be modified in countless ways.

All commercial lumberyards have stock suitable for the construction of these trellises. Two of the more common sizes are ¾ by 1¾ in. and ¾ by 1¾ in., otherwise known nominally as ½ by 1½ in. and 1 by 2 in. These stock sizes may be purchased surfaced on four sides and ready to cut into lengths. Many sizes, both larger and smaller, can be obtained and often are desirable.

In the case of the trellis shown in Fig. 1, for example, the stock used is ¾ by ¾ in., of which 26 ft. are necessary, as well as a piece ¾ by 6 by 14 in. for the brackets. It is put together with half lap joints, although thin, flat strips might be used and a plain nailed joint substituted for the half lap. The half lap joint is not difficult to make and adds much to the attractiveness and solidity of the trellis.

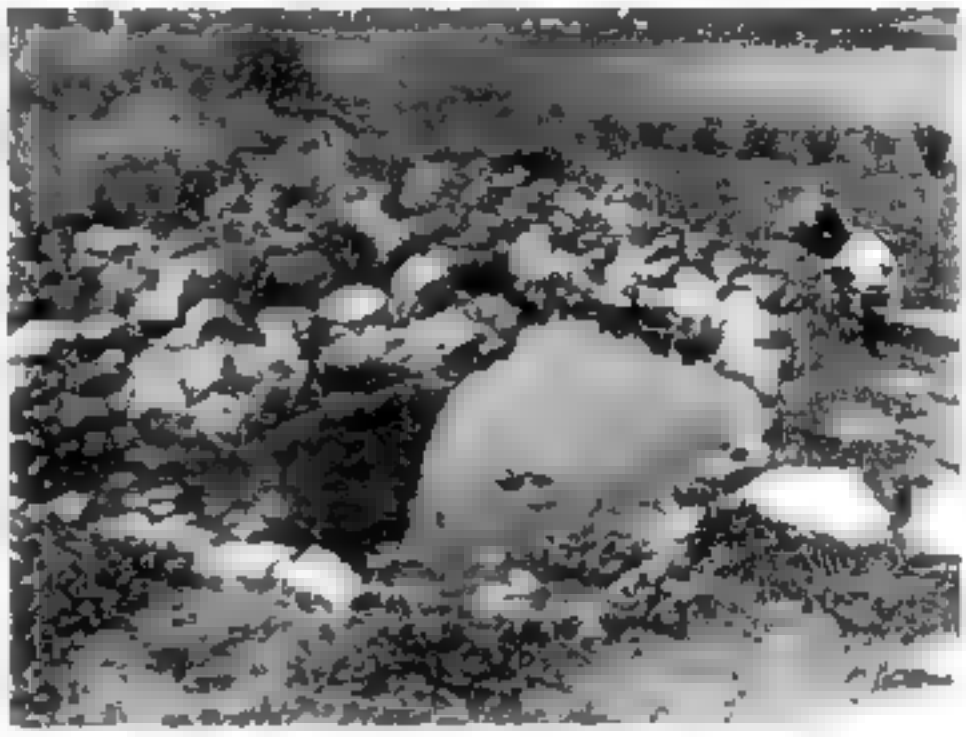
The most important thing in cutting a half lap joint is to have it laid out accurately to start with. In constructing the trellis in Fig. 1, all the parts should be cut to size and laid on the floor in the positions they will have after the joints have been cut. A few small brads may be driven through the members to hold them firmly in

(continued on page 137)

A Lily Pond Needn't Cost Much

Especially If You Make Use of Broken Sidewalk Slabs to Line the Sides—The Sheen of Water Beautifies Any Yard

By B. G. SEIELSTAD

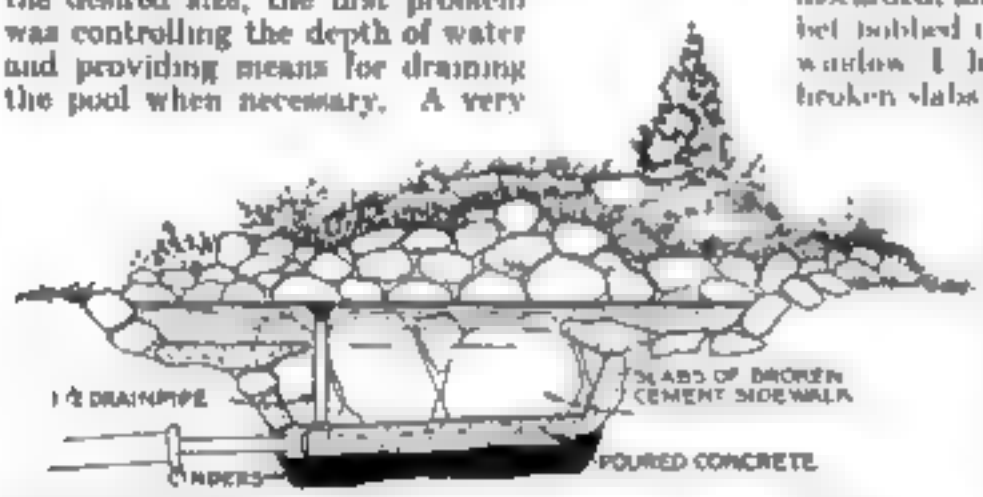


The beautiful little rock-bordered pool for plants and goldfish built by Mr Seielstad.

MOST of us like the shimmer and sheen of a sheet of water near by, and a small back yard furnishes an easy means of gratifying this particular desire.

When the contour of the land is favorable and there is a small stream, a spring or other natural water supply, the problem is comparatively easy; but putting one in a place flat as a billiard table, where the soil is sandy and there are no rocks or boulders for miles, and when one has had no experience with cement, is another matter—the one pictured is the result of this particular set of circumstances.

After digging and shaping the hole to the desired size, the first problem was controlling the depth of water and providing means for draining the pool when necessary. A very simple plan was adopted, as shown in the accompanying drawing.



A sketch by the author showing how the sides were made up of broken concrete slabs. The overflow pipe can be removed for draining the pool.

The real brain-teaser was concreting the sides, as the irregular shape made it almost impossible to build a mold. Various schemes presented themselves and were discarded, and then the one best bet bobbed up. From the train window I had seen a pile of broken slabs of cement sidewalk in a fill along the right of way about a mile and a half from the house so the latter one tenths and I went over in the car and loaded up with all I thought the springs would carry.

These slabs I fitted into place by standing them up edgewise around the sides and cementing together as any ordinary masonry work. The bottom of some of the shallows around the "big deep" are of the same material, with concrete in between. The bottom of the deep part of the pool is about five inches of poured concrete on a bed of ashes eight inches deep.

Broken rock and boulders are piled around the edges to form a rock garden. The boulders are the result of a scouting expedition—the tumble-down foundations of a barn destroyed by fire.

After the concrete had hardened, the day for the first filling arrived with much speculation as to whether there were any leaks. There were, plenty! A liberal use of cement in all suspicious looking places, with repetitions, finally stopped them all.

So far as expense is concerned, I was very fortunate on several counts. Piping for the drain and two bags of cement were the only items purchased.

Homemade Electric Coil for Decorating Wood

SMALL softwood articles such as trays, picture frames, and novelties may be decorated easily and effectively by the pyrographic or burning coil illustrated below. The finished work resembles carved teak wood.

A short, close coil is made from a length of about No. 24 resistance wire.

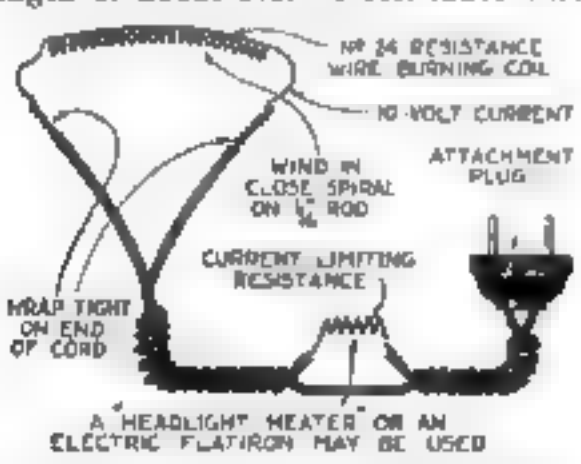
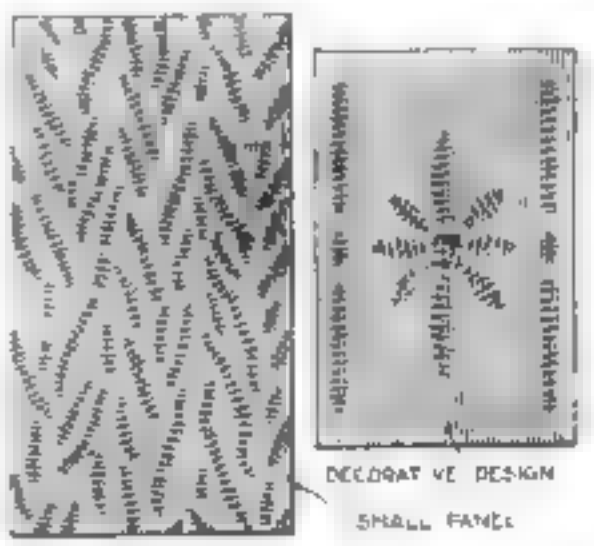


Diagram of burning coil, which is connected to a resistance unit to limit the current

obtainable at any electrical repair shop and is attached to the ends of a lamp cord. In order to limit the current one wire of this cord is passed through an ordinary "headlight" or portable heater; if desired, an electric flatiron can be used in place of the heater, provided it is not allowed to rest upon any inflammable material when the circuit is being used.

The wood article to be treated is sandpapered smooth and the desired design burned in the surface by touching the red-hot spiral to the wood with a rolling motion. A few minutes' practice on a piece of scrap wood will enable the operator to "get the hang" of the process. The charred surface is removed by using a steel wire brush to scrub briskly with the grain.

The article is then given a coat of dark oil stain or wood dye, the surplus being rubbed off with a dry rag as soon as the stain has penetrated the wood. Next a coat of fairly thin white shellac is applied and, when thoroughly dry, smoothed down to a flat, artistic finish with fine steel wool.—S. S. Hood.



Two ways to apply the ornamentation: as an all-over pattern and as separate designs.

Simple Ways to Polish Sheet Brass, Copper, and Silver

By EDWARD THATCHER

POLISHING sheet metal may be said to be the process of taking out one series of scratches with a set of finer scratches until those left are so fine that the eye cannot detect them.

Before polishing, the metal should be cleaned thoroughly and all deep cuts, scratches, or accidental tool marks removed. A stick of carborundum or emery may be used to rub them out as in Fig. 1. The working end of the abrasive is kept wet with water as it is rubbed back and forth over the scratch. For this purpose either a small sharpening stone, a common scythe stone or a section of broken emery wheel is excellent.

A lump of pumice stone is sometimes used to polish sheet metal, particularly silver, the work being kept moistened with water. To polish the metal still further, a piece of water of Ayr stone or Scotch stone, as it is sometimes called, may be rubbed back and forth over the moistened metal. This stone is useful also for removing fine scratches. I have used even a common slate pencil and pieces of fine red shale for this purpose.

Sometimes riffle files serve to remove roughness and scratches from the metal before stoning and polishing. These files, which may be obtained at jewelers' supply houses, usually are elliptical in shape and slightly curved at the ends. A substitute may be made by heating an inexpensive file until it is red, pressing the heated end down on a block of wood to bend it up, and cooling it immediately in water or thick oil.

Fig. 1. A stick of carborundum, emery or other sharpening stone is used to rub out all deep cuts, scratches and harsh tool marks.

Fig. 2. Using a stiff brush to apply a common household polishing or scouring powder to a shallow bowl.

Fig. 3. The object to be polished is held against the underside of the wheel; other positions are dangerous.

Fig. 4. Much hand polishing is done with so-called buff sticks—short lengths of wood to which felt or leather is glued. These are "charged" with a suitable abrasive compound.

Hand polishing has a quality all its own that adds greatly to the appearance of the work. Common household polishing or scouring powders, applied with a scrubbing brush and water, may often be used to advantage (Fig. 2). Pumice stone leaves the metal with a beautiful soft, silky finish, but causes copper and silver to darken; this, however, may be turned to account for coloring some of your work.

Freshly scrubbed metal should be rubbed with an oily rag to retard tarnishing. Floor wax, or clear or tinted lacquer is sometimes used if the piece is to be left without further treatment.

Copper and brass may be given an effective finish by rubbing them with fine steel wool. On flat work, a grained finish may be obtained by rubbing with a piece of emery cloth straight back and forth in parallel lines. Fine wet sand may be used with a scrubbing brush to get a rough polish. To obtain a smoother finish, machine oil should be substituted for water in any of these methods.

For a high polish on metal, hand buff sticks (Figs. 4 and 5) may be used. These are short lengths of wood, like rulers, to one side of which a piece of felt or leather is glued and then "charged" with an abrasive. The buff is rubbed over the work to be polished. Whether purchased or made at home, the sticks are from ¼ to ⅜ in. thick, 1 or 1¼ in. wide, and usually 10 in. long. Felt from old hats or leather from old belts, straps, or shoes will serve to cover them. Some of the commercial buff sticks have walrus hide glued to them, and for fine work, some have chamois.

If the metal is reasonably smooth, you may proceed to polish it with a leather hand buff stick charged with No. 180 emery composition or powdered pumice stone made into a paste with oil. After the work is perfectly smooth, wipe off all traces of the paste and finish the polishing with a felt buff stick charged with rouge composition.

Rouge is a special grade of iron rust used for fine polishing. Emery composition is emery powder made into a cake with a binder or paraffinlike composition, which holds the emery to the polishing wheel or stick. Crocus is a yellow oxide of iron in various grades of fineness, much used for preliminary polishing before the final finishing with rouge. Tripoli is a fine earth in powder or composition form, used for many polishing operations. Carborundum

(Continued on page 183)

How *to* Copy *an* Old Sea Chest

With a Few Dollars' Worth of Pine You Can Reproduce an Unusual Marine Antique from the Peabody Museum

By FREDERICK J. BRYANT

DURING the past few years there has been a tremendous interest in ship model making, and many readers of POPULAR SCIENCE MONTHLY have built models from the plans published in this magazine. Consequently, they have collected a variety of special tools, books, and pamphlets on ship models, templates, and other accessories. It now seems appropriate to offer a drawing of a genuine old-time sea chest in which to store these materials. Aside from its quaint charm and fascination, the chest can be used for this or a number of other purposes.

This chest is one of a number in the marine room of the Peabody Museum at Salem, Mass. It was chosen because it is not too large, is not difficult to build and is attractive in appearance. The cost of the lumber—only from twenty to twenty-five board feet—is only a few dollars.

A chest as well proportioned and decorative as this is worthy of display in any room, particularly one with Colonial furnishings.

The design can be altered in various ways, if desired, to suit individual requirements. For example, the interior can be lined with red cedar, or rope handles can be substituted for the metal ones. A chest of a decorative type, but not so practical, can be made by using a flat cover without any overhang, on the top surface of which is drawn an elliptic measuring, say, 7 by 12 or 8 by 14 in. Within this oval may be painted a picture of a sailing vessel or a marine view.

To make an exact copy of the original chest, select two pieces of white pine ⅞ in. thick, 11 in. wide, and 31½ in. long. The two pieces for the ends are ⅞ in. thick, 11 in. wide, and 15 in. long at the base and 13⅝ in. long at the upper edge.

MAKING the dovetail joints is not a difficult process. A careful layout, sharp tools, and a little patience will insure good results. First select the front side and score a sharp knife line across the board and ⅜ in. in from the end. Do this on all four boards and on both outside and inside surfaces. On the boards for the front and the back measure off with a pair of dividers or compasses a series of ¾-in. spaces (see the detail drawing of the dovetails).

Next take a piece of scrap wood plane a knife line ⅜ in. in from the edge, and lay out a full size dovetail, measuring ¾ in. at the back and ½ in. at the edge.

From this layout or pattern of one dovetail, set your sliding T-bevel to determine the slope of the sides. Then set the bevel against the ¾-in. measurements on the front board, hold it firmly, and mark the lines with a knife. Now pass the lines across the ends of the board using a try-square. Finally, score the lines on the inside of the board, using the bevel again. All the dovetails on both ends of the long pieces should be alike.

Place the board in a vertical position in the vise and saw very carefully just inside the knife lines with a dovetail saw or a fine backsaw. Chisel out the stock between the cuts, being careful not to cut beyond any knife line. Some may prefer to place the board down on the bench and remove the surplus wood with a chisel and a mallet. Every dovetail should be clean-cut, and all uneven spots must be cut away.

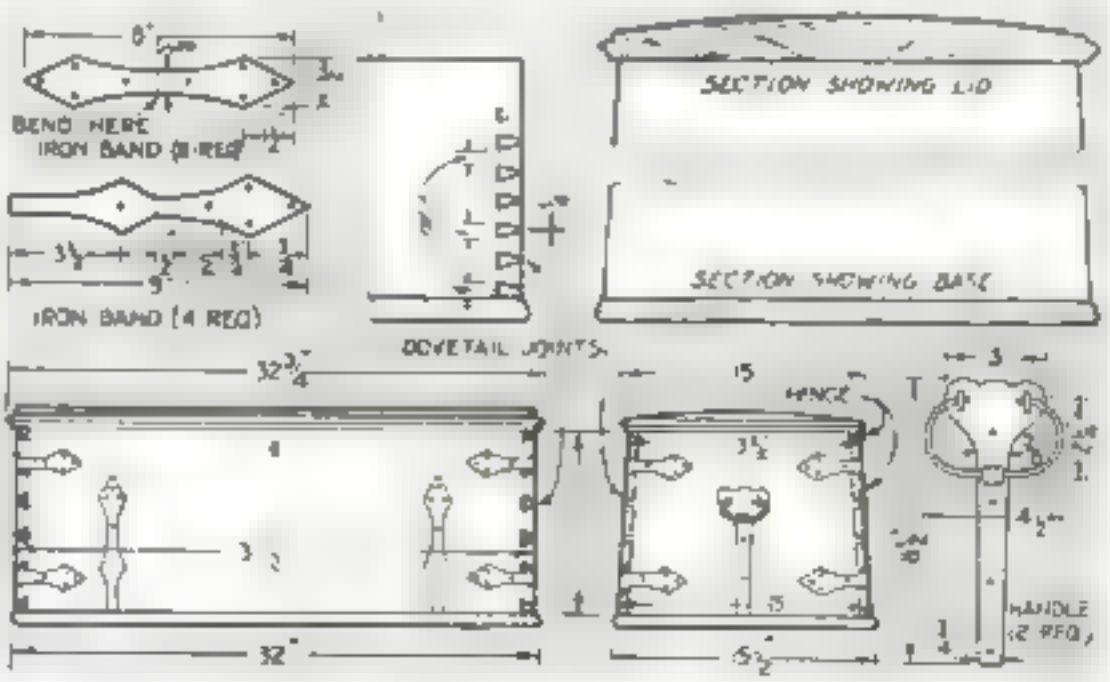
THE next step is to cut the tenons or pins in the end boards. See that the stock checks up with the measurements on the drawing. Place one piece in a vertical position in the vise and set one of the long boards in position on it, lined up corner to corner. Hold it so that it cannot move and with a sharp knife transfer the outline of the dovetails to the ends of the short board. It is a good practice to number the corners of your chest and check these numbers each time the corners are mated.

Take the long board out of the way and square the knife lines from the end layout down each side as far as the ⅜-in. line. This time you are to cut away the stock between the dovetail marks (see the end view of the chest).

Next try to assemble the chest, but do not glue it yet. Check the corner numbers and press the joints together; do not pound the work with a mallet. See that all parts fit snugly and test the assembly with a steel square. If everything is satisfactory, you are ready to glue the joints. Any defective work can be remedied by using a plastic wood composition.

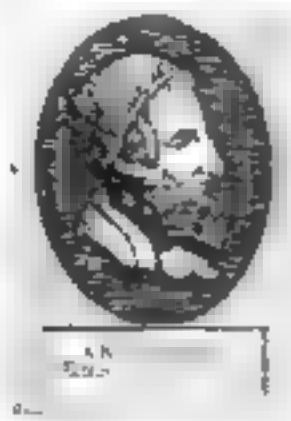
The bottom of the chest is ⅝ in. thick and extends ¾ in. beyond the sides and ends of the box. This edge is rounded over. As the sides slope somewhat, it will be necessary to "level off" the upper and lower edges of the

(Continued on page 156)



Drawings prepared from sketches and measurements made in the marine room of the Peabody Museum, Salem, Mass. The original chest is of pine with thin iron trimmings.

Popular Science MONTHLY



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Air Records That Count

UP IN the air for twenty-six hours, Miss Elinor Smith, seventeen-year-old flyer, recently captured the duration record for women pilots at Roosevelt Field, N. Y. This exactly doubled the record she established last January, only to lose it. By the time you read this, the mark which has already changed hands five times this year may have a new holder.

In striking contrast to the epidemic of transocean flight attempts of recent years, such records as these really advance the cause of aviation. We are beginning to realize that no perilous ocean journey is needed to demonstrate an airplane's fitness. No better or saner proof could be imagined than that of flying safely over a suitable landing field, the motor droning away hour after hour with unfailing regularity.

An airplane that can fly for a day or more without mechanical trouble has given one of the two proofs necessary to show its merit. The other, its ability to lift a load of commercial proportions into the air, is sufficiently exhibited in the tremendous fuel load carried aloft for an endurance flight.

Those who are really helping this country to use its wings are not the performers of hair-raising stunts. They number instead, such aviators as the gallant crew of the Army plane *Question Mark*, 150 hours in the air; the untiring pilot Martin Jensen, whose recent solo flight of thirty-five and a half hours is a world's record, and the plucky sisterhood of women aviators in friendly rivalry for the mark which Miss Smith is the latest to capture.

Something for Nothing

SO LONG as human life exists, there probably will be people engaged in the struggle to get something for nothing. When such people center their activities about fraudulent stock selling schemes and the like we call them "confidence men." Being crooks, they deserve no sympathy.

But there are other seekers after something for nothing who are more to be pitied than blamed. They are trying to get something for nothing by inventing a perpetual motion machine. As pointed out in an article on page 54, even a brief study of basic scientific facts will convince anyone that a perpetual motion machine is impossible. Yet some individuals will persist in butting their heads into a stone wall.

Just recently a man actually obtained a patent in England on a machine supposed to take a small amount of electric power and turn it into a large amount of power. A casual inspection of the patent reveals that the "invention" is simply a make-and-break spark coil operating in a vacuum. Such coils have been known for decades, and operating one in a vacuum can have no worth while effect whatever.

The pity of it is that the time men spend on perpetual motion machines might make them rich if directed in more practical channels.

Outlawing Radio Interference

LAWMAKERS in certain sections of the United States are having a lot of fun trying to legislate radio interference out of existence. They haven't, yet, passed a law against static, nor have they attempted to outlaw thunderstorms, but blanket laws have been passed in various localities prohibiting the operation of electrical machinery capable of causing interference with radio reception.

Such a law goes much too far. Strictly applied, it would cripple electric transportation systems and might even leave whole communities without transportation, light, or power. A law prohibiting the operation of electrical machinery unless equipped with devices to reduce interference to the minimum, administered by men with common sense and thorough technical knowledge of radio, eventually would reduce man-made interference without upsetting legitimate business enterprise.

Rolling Ahead on Wheels

"PLEASE tell me what in your judgment is the world's most important invention." A hard question to answer, that. But why not consider the wheel? Man's progress has paralleled the development of the wheel; we live in a world built on wheels.

No one knows who invented it. Probably some forgotten genius conceived the idea of putting tree trunks as rollers under a burden which had to be dragged along. The idea probably was used in the construction of the Pyramids of Egypt. It survives today in the moving of buildings.

Next, probably, came hollowed logs through which smaller logs were inserted as axles. To these axles was strapped a framework which formed the first wagon. Eventually, disks were attached to these axles and the first wheeled vehicle was constructed.

Today, the wheel is more than a means of transportation. Machine wheels and gears are important factors in practically everything we use. Your watch is a series of geared wheels operated by springs. Wheels run our printing presses, develop electricity, and do the thousand tasks that make of every man a captain of industry, a captain with 300 mechanical slaves at his command.

The wheel is the most important invention because by it man has rolled his way upward.

They Are Saying—

"EINSTEIN ranks high among the foremost scientists of all time who have enriched mankind by their invaluable contributions to thought and human progress."—Herbert Hoover, President of the United States.

"Life may be defined as an electric strain or potential."—Dr. George W. Crile, Director, Cleveland Clinic.

"I'd rather get out of an airplane in mid-air with a parachute lashed to me than leap into the ocean from a ship with a life preserver around my waist."—James K. Clark, U. S. Navy parachute jumper.

"Successful inventing is not confined to the corporation experts, for a host of independent inventors have made fortunes."—Thomas E. Robertson, U. S. Commissioner of Patents.

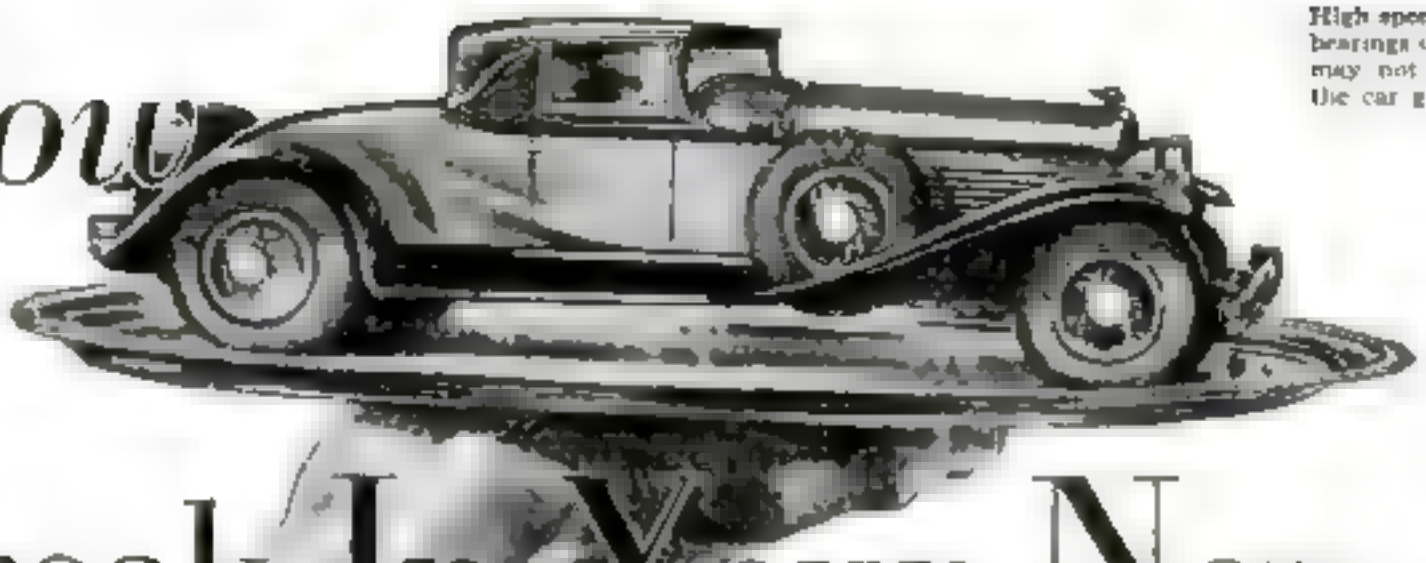
"A certain secretion of the ductless glands, when isolated in pure form, will unquestionably and immediately be used to increase the growth of human beings."—Dr. Oscar Riddle, Carnegie Institution.

"Antarctica is the healthiest place in the world, I believe."—Sidney Greason, chief steward, Byrd Antarctic Expedition.

"The alarm clock and commercial exploitation of 'pep' exercises will make the American people a race of nervous wrecks."—Dr. Jesse Feiring Williams, Professor of Physical Education, Teachers College, Columbia University.

"The world's intellectual need is the presentment of artistic, literary, and scientific discoveries in terms that the public can understand and appreciate, without sacrificing anything in this popular exposition."—Dr. J. W. Harshberger, Professor of Botany, University of Pennsylvania.

How to Break-In Your New Car



High speed takes the life out of the bearings of a new car. The damage may not show itself at once, but the car grows old before its time.

"Stay under twenty miles an hour for the first fifty miles. Gus and Webb [illegible] yes twenty five until you've gone 200 miles

It's a Temptation to Try Her Speed, Says Gus—But if You Hope to Keep Her Smooth and Quiet, Go Gently

By MARTIN BUNN

"HAVE I got to sue out a writ of habeas corpus to get my car, Mr Wilson?" smiled young Webb, the town's newest lawyer as he poked his head in the door of the Model Garage

"You can habeas the corpus right now far as I'm concerned," growled Gus Wilson, veteran auto mechanic as he wiped the perspiration from his face "But by rights, I really ought to call in the coroner and have him hold an inquest over that particular corpus. Honest, Webb, I've done the best I could short of completely rebuilding it. It's running now, but I'm not guaranteeing it Better get a new boat before that one falls to pieces and leaves you sitting in the road"

"That's precisely what I'm going to do," Webb chuckled as he climbed into his ancient car "I've placed the order already Going to take delivery month after next, the day before I get married, and we're going on our honeymoon in the new car"

"Why the delay?" Gus asked. "Can't they make delivery before that?"

"Certainly they can" Webb replied, "any time I say. But I thought it would be nice to have a brand-new car to start the trip."

"That's bum dope," grunted Gus. "First place you ought to drive a new car real slow for the first thousand miles, and that would be a nuisance on a tour Besides, little troubles may develop in a new car during the first thousand miles. Anything wrong in the assembly or adjustment usually shows up then. Better get the car as soon as you can and work it in before you start the trip."

"You've made out a prima facie case, Gus," Webb admitted. "I'll tell the agent I want the car now"

Two weeks later the young lawyer drove up in a brand-new coupe.

"Well, gentlemen of the jury, what's your verdict?" he grinned.

"Looks good now," Gus commented. "I hope you'll keep it that way"

"Status quo, as it were," agreed Webb. "That's what I want to do if you'll show me how First off, I'll issue a restraining order against jamming the throttle against the floor boards to see how fast she'll go. Why is it so necessary to drive a car easy at the start. Don't the parts fit?"

"Certainly they do," Gus replied "It isn't that at all. It's a matter of surfaces. The walls of the cylinders or the bearings on the crank shaft, for instance, look smooth and polished, but if you could see 'em under a microscope, you'd be surprised how rough they really are—full of little ridges and valleys and pits."

"But I thought the oil kept the surfaces from touching each other," Webb interrupted.

(Continued on page 140)

Ask Gus—He Knows

"YOUR ears can help you keep your car in shape. With a little training, they'll sort out the harmless squeaks and rattles from other sounds that tell of trouble. Tune your ears to the music of a sweet running machine, and when some part plays a sour note, you can't help noticing it. For instance, if there's an unusual hum or growl from the rear end, probably the ring gear is coming loose. A grating click that keeps time with the motor would tell that perhaps there's a tooth busted off the pinion."

Building a Fast Yacht Model

How to Mold the Lead Keel and Make the Rudder Painting the Hull—Mast, Spars, Sails, and Fittings

By A. M. YOUNGQUIST

IF YOU have the hull of your model yacht, the *Sea Scout*, constructed to the point described in the June issue, you are ready to mold the lead keel.

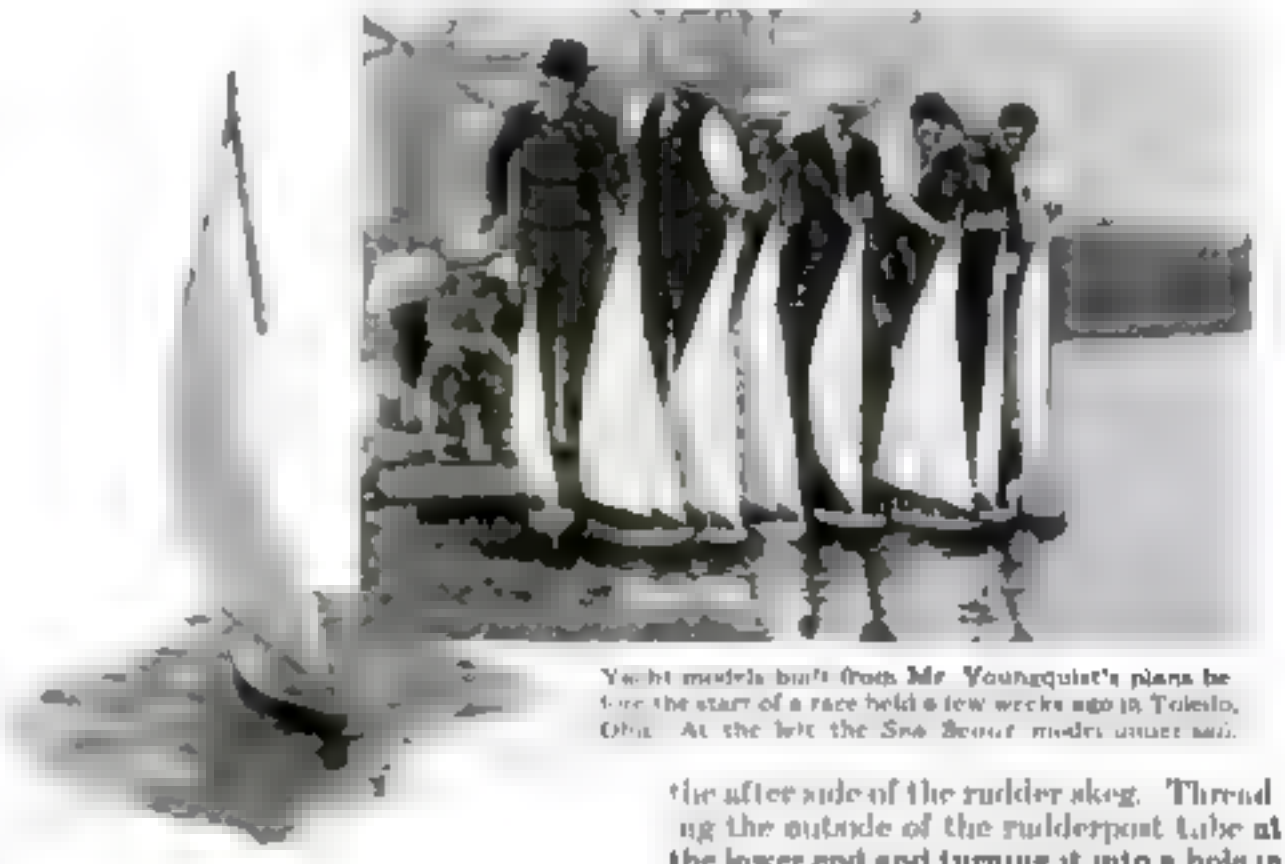
Those who missed the previous article yet wish to build this improved design for a 42-in. racing model can begin now without difficulty, for complete drawings can be had by sending for POPULAR SCIENCE MONTHLY Blueprints Nos. 106 and 107 (see page 109).

It is necessary to make a split wood pattern of the lead keel—a pattern split vertically in half the long way. Two short pegs are set in one half of the split pattern to fit in corresponding holes in the other half; these pins should extend about ¼ in. and fit loosely in the holes. The pattern should be slightly larger than the finished keel to allow for trimming, fairing to the hull, and smoothing.

For the molding, two molder's flasks and molder's sand of proper consistency and dampness are desirable, although homemade flasks and plaster of Paris (instead of molder's sand) may be used, the latter making very smooth castings.

Detailed information on pattern making and molding may be found in any public library. It is advisable to obtain such information or to visit a foundry; however, the drawings on page 120 show the molding in detail. About 8 lbs. of pure lead are required, also an iron kettle and a ladle for pouring. Lead becomes molten at a relatively moderate temperature, so that the heat from an ordinary gas burner is sufficient.

The cast-lead keel should be smoothed and accurately fitted to the wood hull

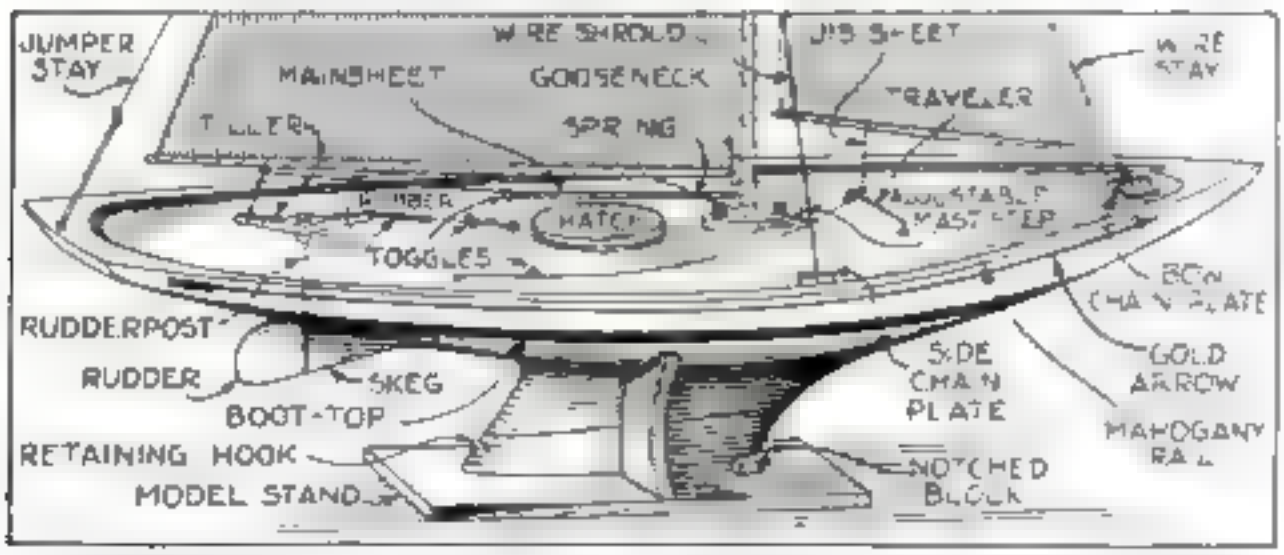


Yacht models built from Mr. Youngquist's plans before the start of a race held a few weeks ago in Toledo, Ohio. At the left the *Sea Scout* model under sail.

with ¼- or ⅜-in. bolting bolts. These may be cast into the lead or tapped into it afterwards; or holes may be drilled all the way through the keel and the bolt-heads countersunk in the lead. The keel should be trimmed away as necessary to obtain the correct trim and weight, so that the model will float on the designed load water line. Use a generous amount of white lead in the bolt holes and between the lead keel and the deadwood to insure a water-tight job.

A hand plane or any cutting tool may be used on pure lead without injury to the tool. A coarse cabinet rasp also is useful for trimming the lead. When the keel is secured to the hull and finally shaped and faired to the deadwood, it should be sanded smooth. The finished keel should weigh about 5.3 lbs.

For the rudderpost a ⅜-in. brass tube is fitted through the hull. Care should be taken to drill close to, and in line with, the after side of the rudder skeg. Threading the outside of the rudderpost tube at the lower end and turning it into a hole in the wood slightly smaller than the tube insures a tighter job. It is advisable to use white lead in this hole also.



Completed hull of the 42-in. model showing all the deck fittings and the stand. For full working drawings refer to POPULAR SCIENCE MONTHLY Blueprints Nos. 106 and 107 (see page 109).

THE model should be carefully cleaned and sanded with No. 00 sandpaper preparatory to applying the paint and finish. The model may be painted, enameled, varnished, or lacquered in a variety of suitable colors. For a paint or enamel job, a thin priming coat of white lead and oil is applied. Care must be taken not to paint out the load water line—the glue line between lifts *D* and *E*. A narrow stripe—"boot-topping" or "boot-top" for short—of contrasting color is usually painted between the top-side paint and the bottom paint. A strip of adhesive tape, cut to the boot-top's measurements, may be applied to the hull while painting above and below. When removed, it leaves a clear-cut line of the desired width for the boot-topping paint.

At least three coats of any finish should be applied and each coat (except lacquer, which should not be sanded between coats) lightly sanded with No. 00 sandpaper. The final coat should be rubbed with pumice- or rottenstone and oil. A high-grade standard finish should be used, and the varnish must be of the quality known as "outside spar."

If desired, a gold or bronze arrow stripe may be painted just below the deck line. The name should be painted across the stern transom.

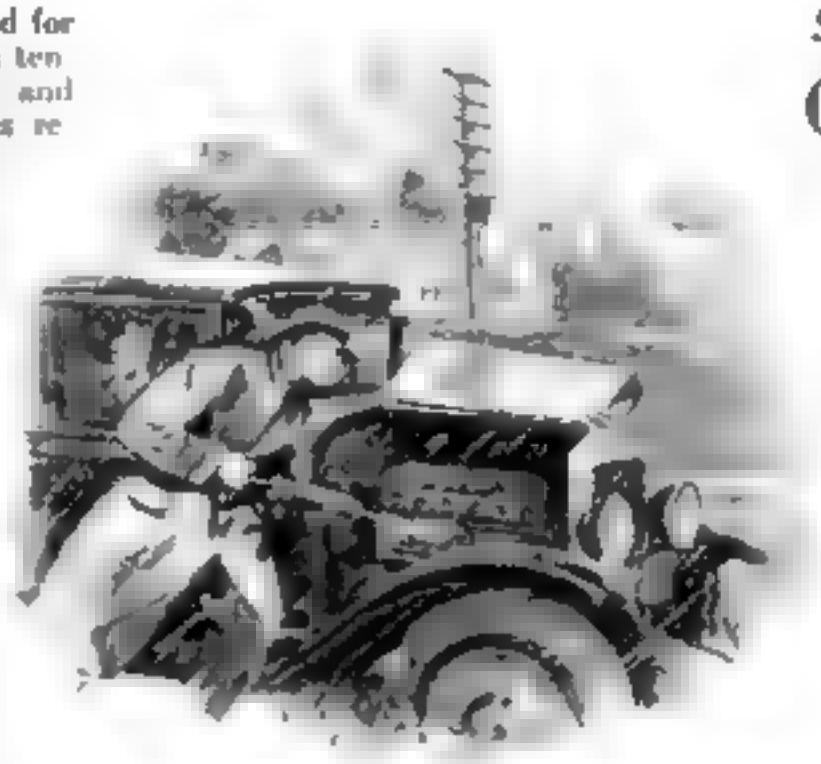
One of the most attractive Waite High School models is built of mahogany, the topsides being filled with light brown paste wood filler and varnished and rubbed. The bottom is marine green, the boot-topping a gold bronze. Another attractive color (Continued on page 120)

Handy New Kinks for Motorists

If You're Stalled in the Rain

A Fire Extinguisher Will Help You "Put Out" the Dampness—Ideas and Tools Others Find Helpful

OFTEN when a car has stood for hours in the rain, wet high tension wiring, spark plugs, and distributor head sometimes result in a dead ignition system. At the right is shown an emergency method of getting started. Take your fire extinguisher and squirt some of the solution it contains on the distributor head, wires, and spark plugs. Do not use too much. The extinguisher liquid is carbon tetrachloride. It will carry away the moisture and then itself disappear by evaporation.



Fire extinguisher fluid drives out rain-soaked ignition system and helps start the motor

Finding Loose Bearings

IF MYSTERIOUS knocks and noises in the motor make you doubtful about the condition of your connecting rod bearings, the next time you take off the head to scrape the carbon and grind the valves press a plumber's force pump against the head of a piston, and attempt to move the piston up and down, as shown in

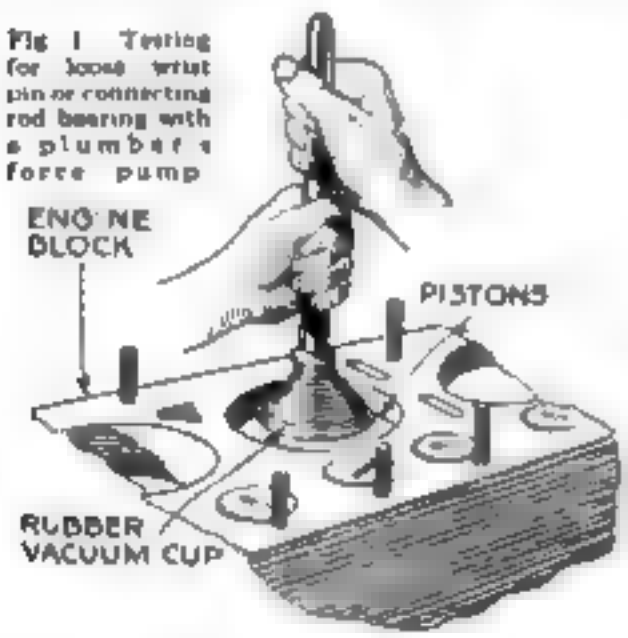


Fig 1 Testing for loose wrist pin or connecting rod bearing with a plumber's force pump

Fig. 1. Any appreciable motion indicates that either the wrist pin or connecting rod bearing is loose, and perhaps both.

Light for the Gas Gage

THE experience of getting stuck on the road at night with an empty gas tank often is due to inability to read the gage on the tank owing to lack of light. A remedy for this trouble is shown in Fig. 2. If there is no spare tire or other intervening object between the tail-light and the gage, simply drill a small hole in the side of the tail-light, so that a beam will be projected directly on the dial. If you are careful to get the hole in exactly the right place, it can be very small. Try a small hole to start with and if the beam of light doesn't hit the gage, you can enlarge the hole with a small rat-tail file. If the tail-light is shielded from the gage, so a direct beam of light is impossible, use a small mirror to reflect the beam.

RUSSELL MARTIN, of Turners Falls, Mass., wins this month's $10 prize for his suggestion for illuminating the gasoline gage, shown in Fig. 2. Each month POPULAR SCIENCE MONTHLY awards $10, in addition to regular space rates, for the best idea sent in for motorists. Other contributions used are paid for at the usual rates.

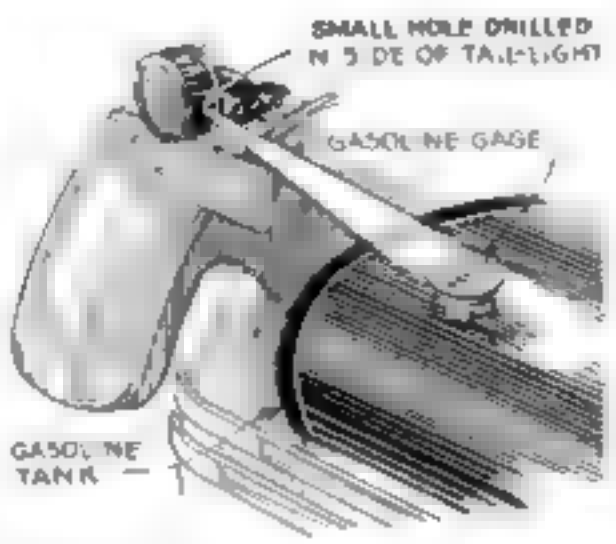


Fig. 2. A small hole drilled in side of tail-light illuminates gas gage on tank for night reading.

Simple Pipe Flaring Tool

CERTAIN types of gasoline pipe unions require that the end of the pipe be belled out into a smooth flare. Flaring the pipe can be done easily by the tool shown in Fig. 3. Take a finishing nail and bend a kink in it as illustrated. Cut off the head of the nail so it can be held in the chuck of a hand drill. The end of the pipe should be clamped in a vise, using grooved wood blocks to prevent crushing it. Rotating the nail will form a smooth flare on the end of the pipe. The turning motion should be slow and the pressure relatively heavy to obtain the best results.

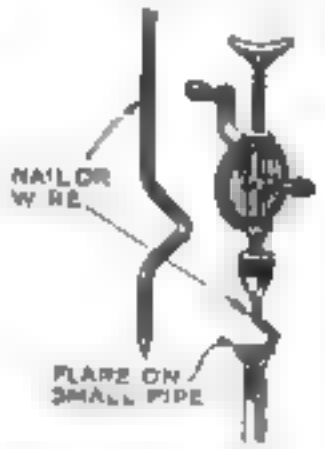


Fig. 3. A bent finishing nail, used in a hand drill, makes useful tool for flaring a pipe end.

Cleaning the Starter

THE bendix type starter will not work perfectly unless it is kept clean and free from oil. It should never be lubricated. In most cars the bendix drive is inclosed in the flywheel housing, and while the housing is supposed to be free from oil, some oil may be thrown on the bendix from the clutch mechanism. The usual method of cleaning the bendix is to remove the starter motor. You can, however, drill and tap a hole in the flywheel housing at a point where an oil can spout inserted in the hole will squirt cleaning gasoline on the bendix parts, as shown in Fig. 4. Do not use kerosene as the cleaning fluid because enough of it will adhere to the parts to collect dust and cause gumming.

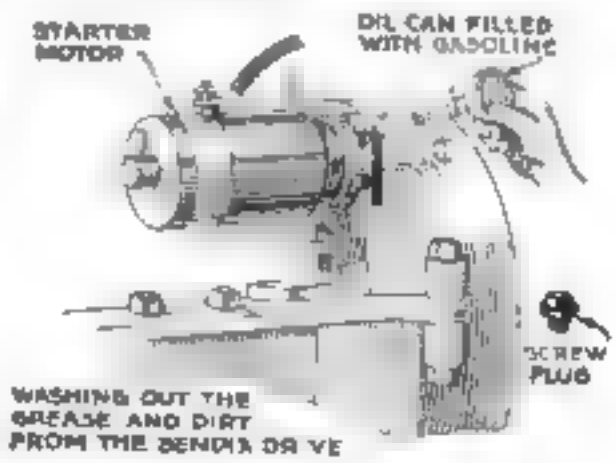


Fig. 4. A simple method of cleaning the bendix drive without removing the starter motor.

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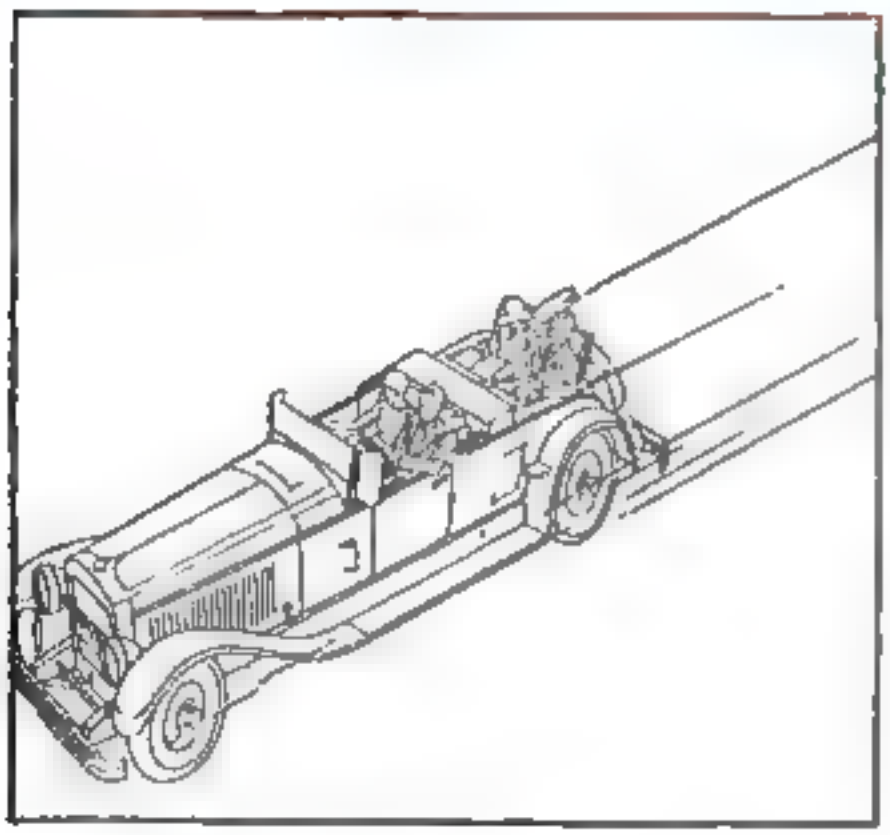
Make this chart your guide

It shows the correct grade of Gargoyle Mobiloil for every prominent car. If your car is not listed below, see complete Mobiloil Chart at your Mobiloil dealer's.

NAMES OF PASSENGER CARS	1929 Engine		1928 Engine		1927 Engine		1926 Engine	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Auburn, 6-66							A	A
8-cyl	BB	Arc	BB	Arc	BB	Arc	A	Arc
" other models	A	Arc	A	Arc	A	Arc	A	A
Buick	BB	Arc	BB	Arc	BB	Arc	A	Arc
Cadillac	BB	Arc	BB	Arc	BB	Arc	BB	Arc
Chandler Special Six			A	Arc	A	A		
" other models	A	Arc	A	Arc	A	Arc	A	Arc
Chevrolet	A	Arc	A	Arc	A	Arc	A	Arc
Chrysler 6-cyl			A	Arc	A	Arc	A	Arc
" imperial	BB	Arc	BB	Arc	A	A	A	A
" other models	A	Arc	A	Arc	A	A	A	A
De Soto	A	Arc						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc
Elcar	A	Arc	A	Arc			A	Arc
Essex	A	Arc	A	Arc	A	Arc		
Fisher	A	Arc	A	Arc	A	Arc	A	Arc
Ford, Model A	A	Arc	A	Arc				
" Model T					F	F	E	F
Franklin	BB	Arc	BB	Arc	BB	BB	BB	BB
Gardner, 8-cyl	BB	Arc	BB	Arc	BB	Arc	A	Arc
other models							A	A
Graham-Paige	BB	Arc	BB	Arc				
Hudson	A	A	A	Arc	A	Arc	A	Arc
Hupmobile	BB	Arc	BB	A	A	Arc	A	Arc
La Salle	BB	A	BB	A	BB	Arc		
Marmon, 8-cyl	A	A	A	Arc	A	Arc		
" other models			BB	A	A	A	A	A
Moon	A	Arc	A	A	A	Arc	A	Arc
Nash, Ad. 6 Sp. 6	BB	A	BB	A	BB	A	A	Arc
" other models	A	Arc	A		A	A	A	Arc
Oakland	A	A	A	Arc	A	Arc	A	Arc
" 8-cyl	A	A	A	Arc	A	Arc	A	Arc
Peerless 72 90 91	BB	A	BB	A	BB	A	BB	A
other models	A	A	A	Arc	A	Arc	A	Arc
Plymouth	A	Arc						
Pontiac	A	Arc	A	Arc	A	Arc	A	Arc
Reo	A	A	A	Arc	A	Arc	A	Arc
Stearns Knight, 8-80	BB	Arc	BB	Arc				
other models	BB	A	BB	A	BB	A	BB	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc
Velie, 8-cyl	BB	Arc	BB	Arc				
6-cyl	A	A	A	Arc	A	Arc	A	Arc



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A Wood Turner's Bag of Tricks

Easy Ways to Embellish Plain Lathe Work with Reeds and Flutes -How to Carve Spirals by Hand

By HERMAN HJORTH

TURNED work may be decorated by a few simple forms of wood carving. Although such carving greatly enhances the beauty as well as the intrinsic value of the piece, it requires little practice and no outlay for new tools.

Reeding may be described as the process of carving beads or astragals on a turned column. First make the sides and ends of a box such as would be needed if the column had to be packed and shipped (Figs. 1 and 2). Remember that this box has neither cover nor bottom.

Draw a vertical center line on the ends of the box and place the turned piece in the box so that the surface to be reeded is about level with the upper side of the box. Mark where the centers of each end of the piece should be located on the vertical center lines drawn on the ends of the box. Bore ⅜-in. holes at these points, insert ordinary wood screws from 1½ to 2 in. long and screw them into the centers of the turned piece.

In Fig. 2 (at the left) the screw at one end is much nearer the top of the box than that in the other end. This is because the turned piece is of a larger diameter at one end than at the other, and in order to bring the surface to be reeded level with the top of the box, the end having the greater diameter must be lower than the other.

The column is now divided into the desired number of divisions. Wrap a strip of paper around the column at any point, cut it so that the ends just meet, remove it, and lay out the divisions. For an even number like sixteen, this may be done by folding the paper; for an uneven number, the divisions should be stepped off with a pair of dividers. Wrap the paper around the column again, hold it firmly in place, and transfer the divisions to the column with a pencil (Fig. 1).

Now set a marking gage to half the outside width of the box, and gage lines along the entire length of the portion to be reeded at all the division points laid out from the strip of paper as shown at the left of Fig. 2. Let the point of the marking gage project about ⅛ in. and hold the block firmly against one side of the box.

BEGIN chiseling V-cuts on the lines just gaged as indicated at the right of Fig. 2. Use an ordinary ½-in. paring chisel, preferably with a long blade that is beveled along its sides. Fasten the box holding the turned piece in a bench vise and drive a small wedge between the side of the box and the turned piece so as to hold it firmly during the carving process.

Fig. 1. Marking a column to be reeded. The divisions are transferred from a paper strip.

Be careful to note the direction of the grain, and do not make too deep or too large cuts, thereby losing control of the chisel. Gradually deepen the V-cuts and then round the edges slightly. Finish with a scraper and sandpaper.

Reeds may be applied to advantage to a number of projects such as lamps, stands, tables of many kinds, mirrors (see the preceding article in the June issue), and the edges of table tops.

The tables shown in Figs. 3 and 4 (which differ in respect to the shape of the top) are typical of how turned work may be decorated by reeding.

To make the round top and the apron, as in Fig. 3, draw a full size layout on a plywood panel or a piece of heavy paper. Templates should be made from this full size drawing, from which the four pieces forming the apron may be cut. As the apron is only 2 in. wide, it may be cut from a 2-in. plank. These pieces should be sanded in the lathe by the method illustrated in Fig. 7, page 124.

The segments must be fitted together and joined with ⅜-in. dowels. To mark for the dowel holes, gage a vertical center line on both ends of each of the four pieces forming the apron. Do this by holding the back of the marking gage against the convex sides of the pieces. Then set the marking gage to ½ in. and gage horizontal lines on both ends of each piece. With a setting of 1½ in. gage another set of horizontal lines on the ends of the four pieces. The intersection between the two horizontal gage lines and the vertical ones are the points where the holes for the dowels are to be bored.

GLUE the four pieces of the apron together by wrapping a piece of sash cord twice around them and twisting it tightly with a small stick. Clamp the apron to a flat surface while the glue is drying—the table top will do. When the glue is dry, sand off the unevenness at the joints on the disk sander. Finish by hand sanding, and screw the apron to the underside of the top.

Fig. 2. At the left is shown how the marks for the reeds are scored with a marking gage; at the right is illustrated the method of chiseling out the reeds.

The column is reeded as explained above. The method of sawing out the legs and fitting and gluing them to the column was fully described in the July, 1928, issue of this magazine (page 90).

The column and the top are joined together by means of a piece 1 by 3 by 16 in., shown by dotted lines in Fig. 3. This is screwed to the underside of the top at right angles to the direction of the grain in the latter. The tenon turned on the end of the column is glued into a corresponding hole bored in the center of this piece.

The photograph, Fig. 4, shows flutes cut into the legs.

(Continued on page 92)

A Wood Turner's Bag of Tricks

(Continued from page 90)

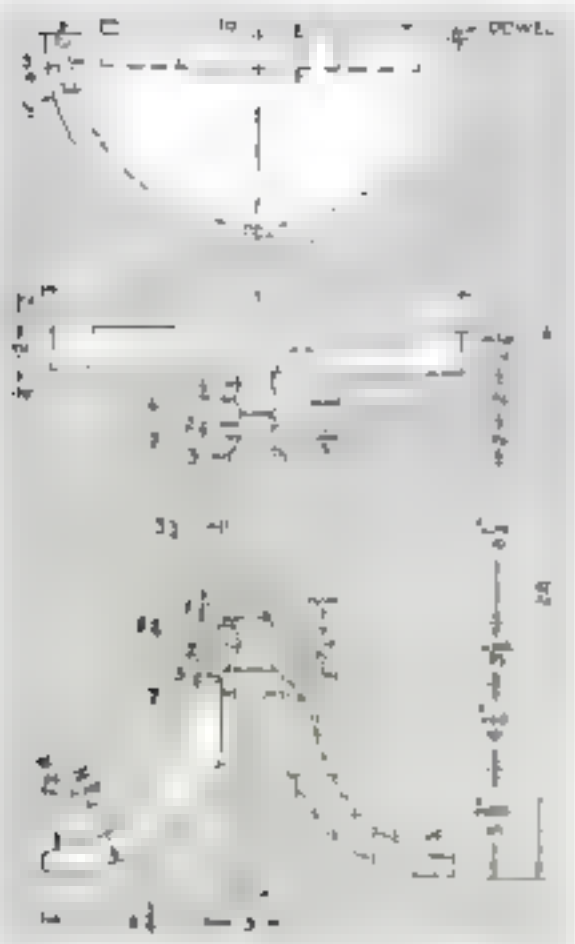

Fig. 1. Graceful round table with turned and reeded column and band sawed and reeded legs.

Flutes are laid out in the same way as reeds, but they are cut with a gouge. They are more difficult to cut than reeds

If it is desired to make spiral reeds instead of straight reeds, the part of the column to be reeded is divided into the same number of parts at each extremity by the method shown in Fig. 1. Then cut a strip about ⅛ in. wide from a piece of heavy paper or flexible cardboard and use this as a ruler. Select a point at the lower end of the part to be reeded and wrap the flexible strip about the column, for example halfway around. Draw a line along its edge, move it to the next pair of points, and continue in this manner until all the reeds have been marked. Cut and shape the reeds as described above. Spiral reeds are easier to cut than straight reeds because they do not follow the grain of the wood.

SPIRAL turning is of Eastern origin. In the seventeenth century examples of this form of decorative art were brought to Europe by Portuguese explorers. It was incorporated in the prevailing type of furniture design and became very popular.

Spiral turning is done commercially on special wood-turning lathes. The method described in this article, however, is the old-fashioned hand carving used by the individual craftsman. Like reeding, spiral carving is easy to do and requires little or no previous practice.

Figure 6 shows the method of laying out various types of spirals. At *A* is shown a common single spiral. The part to be carved is turned as a plain cylinder and divided lengthwise into a number of equal parts, the length of each being about equal to the diameter of the turned cylinder in this case 2 in. Divide each of the major parts into four equal parts and mark circles at all these points around the cylinder

Wrap a strip of paper around the cylinder and divide it into four parts. Move the T-rest close to the cylinder and draw four horizontal lines, *a*, *b*, *c*, and *d* at the points laid out from the paper strip.

Start the spiral line at one end of the cylinder on one of the horizontal lines (in this case line *a*). Proceed to the intersection of the line *b* and circle *1*, then continue to line *c* and circle *2*, then to line *d* and circle *3*, and around to line *a* and circle *4*.

One complete revolution of the spiral line has now been made. Continue drawing the spiral in this manner until the other end of the cylinder has been reached. Do not let the spiral begin or end too abruptly, but make it more nearly parallel to the turned beads at both ends.

Fig. 4. A clover leaf top, reeded column, and fluted legs are the features of this little table.

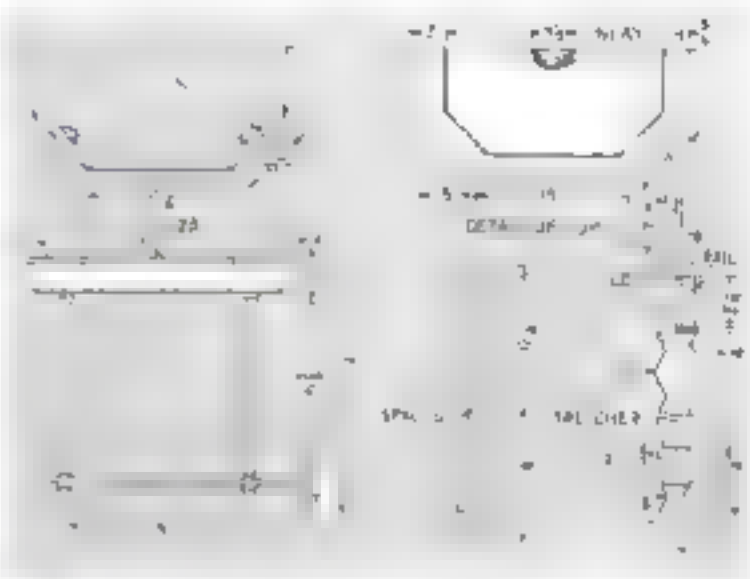

Fig. 3. Assembly views and working details of a coffee table that is a typical example of the use of spiral turnings.

WITH a backsaw cut along the spiral line, at the same time revolving the lathe slowly by hand. Chisel a V-cut with an ordinary ½-in. chisel to the bottom of the saw cut. Then file along the bottom of the V-cut with a round file. Round off the edges with a half-round file or rasp and finish with sandpaper. These various steps are clearly shown at the left in Fig. 6, page 124

If the spiral is to taper, it is laid out as shown at *C* in Fig. 6. Measure the diameter at the larger end and lay off this distance along the cylinder. Then measure the diameter at this point and lay off the distance along the cylinder. Continue in this way until the small end of the cylinder has been reached. The lengths are now slightly adjusted so that they diminish proportionately and add up to the total (Continued on page 124)

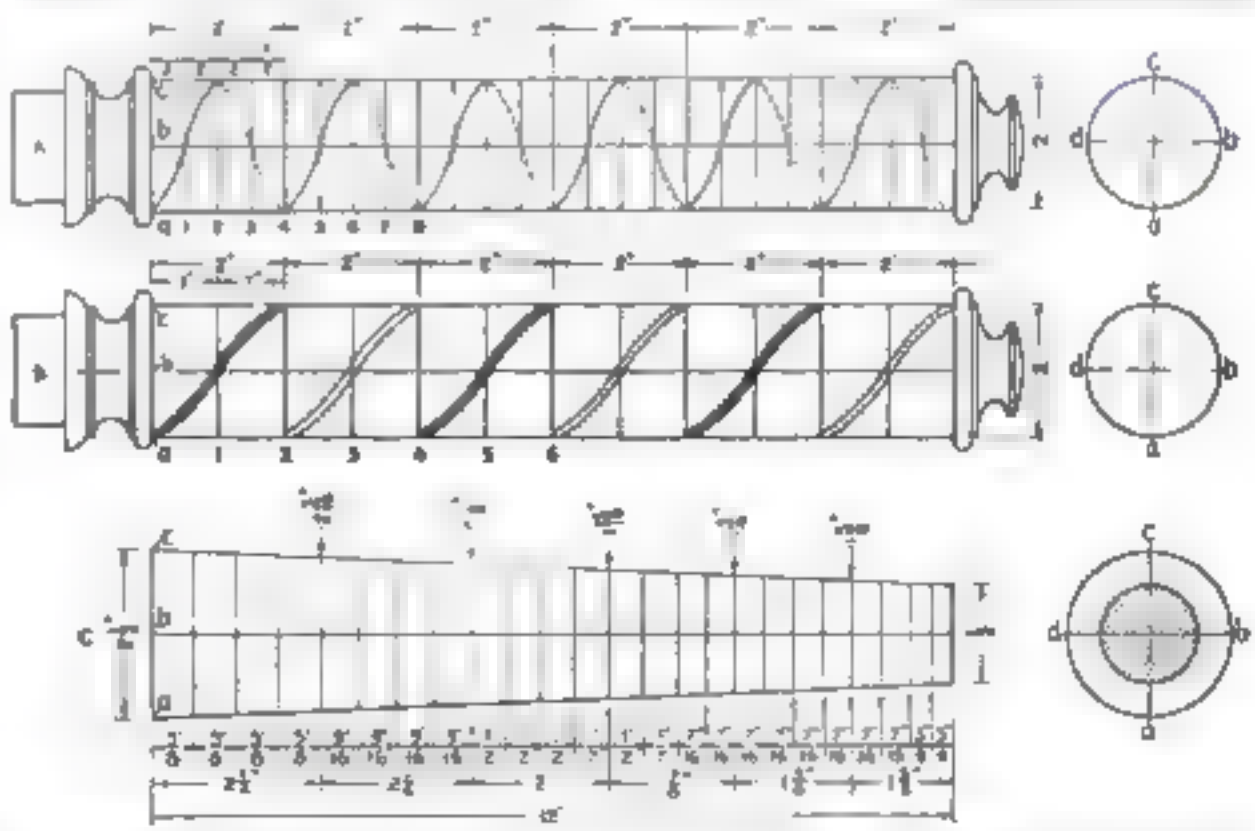

Fig. 5. Diagram to illustrate the method of laying out spiral turnings. At *A* is shown a common single spiral, at *B*, double hollow spirals, in which the lines are left high like ridges; at *C*, a tapered spiral.

How to Use Narrow Band Saws

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Files for the Metal Worker

Every kind, size and style. A Disston 8-inch Mill File, bastard cut, is fine for sharpening axes, lawn mowers, garden tools, and general work in the home and shop. Excellent for finishing metal surfaces. 25 cents each.

SEE that band saw is not too wide for the cut to be made. Use narrow saws for sharp curves and angles. Be sure your saw is sharp and has sufficient set to prevent it from binding.

Wheels should be clean and run true. Strain blade over wheels to give correct tension, so saw will not slip. Guide wheel must turn freely; it should not press too hard against blade.

Close guard door over the upper wheel. Set guides just high enough to clear work to be cut. Get full speed before starting cut. Follow outside of line marked on work leave line on the finished piece.

In cutting curves, use one hand as pivot and turn work with other hand. Never try to pick pieces of wood out of the table slot while saw is running. In backing out of cut, don't twist saw.

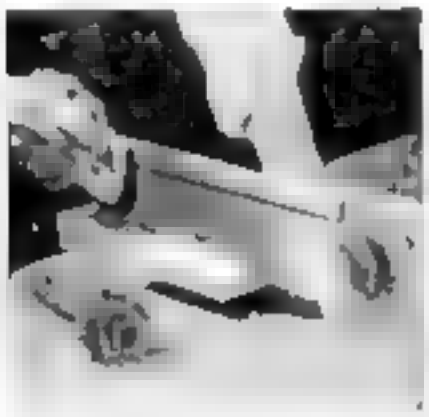
Disston "Thin Gauge" Narrow Band Saws are best for all machines with wheels up to 20", which require flexible blades because of the bending strain. The smaller the wheels, the thinner the saw required. Disston Regular Gauge Band Saws are best for wheels larger than 24".

Disston Thin-Gauge Band Saw, 8' 8" long, ¼" wide, 24 gauge, brazed. Last print, $4.05. Other sizes at proportionate prices.

Your hardware dealer has in stock, or can get for you quickly, any size or style of Disston Narrow Band Saw or Circular Saw, to fit your machines.

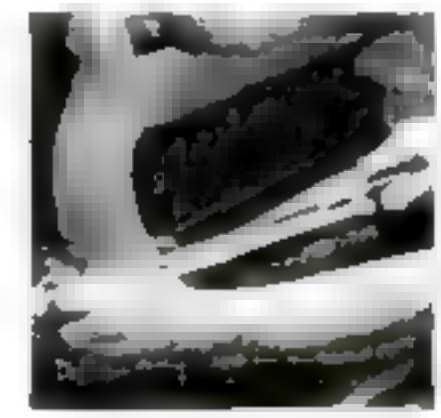
"The Saw Most Carpenters Use"

The two handiest saws for the home workshop are the 26-inch 8-point for cross-cutting, and the 26-inch 5½-point for ripping. You will need them on almost every job. The popular "D-8" Lightweights cost $1.45.



Handiest of All Small Saws

The Dock Saw, with fine teeth and stiff back, enables you to do smooth, accurate cutting of mitres, grooves, etc., for making furniture, picture frames, etc. Disston No. 4, 12" blade, 3" under back, 14-point, costs $1.80.

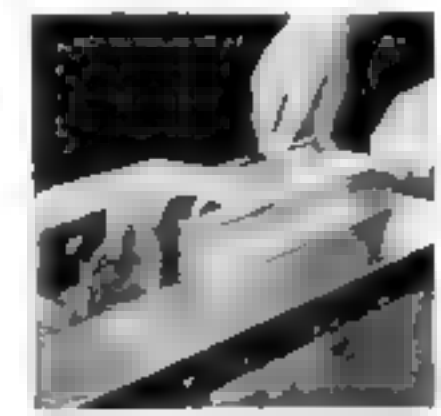


For Use in Close Quarters

Disston No. 200 Back Saw Frame enables you to cut where wide frame can't get in. Only ½ inch from tooth-edge to inside of back. Takes 8" bl. dea. Frame 70 cents. Disston Back Saw Blades, 8", 80c doz., 10", 90c doz., 12", 75c.

For Finishing Wood Surfaces

For giving a fine finish to your work, removing paint, etc., use a Disston Arms Cabinet Scraper, made of Disston Saw Steel. Made in all needed sizes, 2 ½" and 2 ½" wide and 3" and 6" long being standard. 35c and up.



For Your Power Saw Outfit

Disston Saws insure better work. Cut easier, stay sharp longer. Disston Circular Saws—cross-cut, rip or combination—are made to fit any make of machine. If your dealer cannot supply you, write to us.

DISSTON

Makers of "THE SAW MOST CARPENTERS USE"

Every saw user will enjoy reading "The Disston Saw, Tool and File Book," an illustrated manual on the selection, care, and use of tools. Tells how to file and set saws, etc. Contains helpful information on hand saws and circular saws. Use coupon, or write.

Henry Disston & Sons, Inc., Philadelphia, U. S. A.
(In Canada, address Henry Disston & Sons, Ltd., Toronto)
Please send me "The Disston Saw, Tool and File Book."

Name and Address_____

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How to Test Your Squares

The Accuracy of Fine Shopwork Depends on Having Them "Right to the Scratch"

By HENRY SIMON

Testing a toolmaker's square with a cylinder on a surface plate. A dial indicator shows exactly any deviation.

MANY mechanics believe that the comparison of two different squares in a number of positions will prove whether they are true. In an article, "Squaring Your Squares," published in the September, 1928, issue of POPULAR SCIENCE MONTHLY, the writer showed that most of the "proving" done in this way is entirely unreliable.

The first item to check in any square is the straightness of the handle and blade edges. This is usually taken for granted, but does not always exist. As shown at *A* and *B* in Fig. 1, lack of straightness may lead to various results. Indeed, accuracy in a square is a meaningless term unless it is first known that all contact edges are straight.

In speaking of squares, it is necessary to make a distinction between two main classes. One of these is the "sliding head" combination square, which is so popular. The other is the toolmakers' rigid try-square. Notwithstanding claims to the contrary and occasional exceptions, sliding head squares are rarely accurate to within less than .001 in. plus or minus at the end of a 6-in. blade, and many of them deviate considerably more. The higher priced toolmaker's try-squares, on the other hand, should be accurate to within one tenth that amount.

With the accuracy of the combination square only a fraction of that of the solid try-square, it is, of course, practical to test the former against the latter. As the test is usually carried out, however, the amount of deviation is only guessed. A better way is by the use of "feelers" cut from shim metal and used as at *A* and *B* in Fig. 2. The edges of the feelers should be smoothed and examined under a strong glass to see that they have no burr. Shim metal is readily obtained in sizes from .001 in. upward, so that any difference of over .001 in. can be easily detected in this manner. Commercial feelers or thickness gages can be used equally well.

Another good method for moderate accuracy, and one which has the advantage of being independent of that shown in Fig. 3. All that is required is a plate of soft metal with a polished surface and one straight edge. The square is applied twice as shown, and a very fine line drawn with a sharp needle point each time. The lines should be .010 in. or less apart. Examination under a strong glass at points *a* and *b* will show the presence of any error greater than .001 in., the error appearing doubled by virtue of the reversal of the tool.

MEANS of another order must be used in testing one of the highly accurate solid try-squares. A simple way, which is not new, is by the use of a true cylinder, as in Fig. 5. The cylinder should have a diameter slightly less than the length of the square handle. Provided that it is a highly accurate job, the cylinder will give a reliable check for the truth of a square inside and out. It should not be forgotten that two true right angles may still be off in relation to each other, as is strikingly illustrated in Fig. 4. To make the test complete, therefore, the parallelism of the blade and handle should be established by measurement with a micrometer.

By using a .001-in. feeler with the test cylinder, we can instantly ascertain whether the difference is less than that amount, as it should be. Usually an attempt is made to estimate the error by eye, but that can be done only roughly. The "light crack" method is excellent for showing the *existence* of a minute space; it does not permit even an approximate guess as to the amount.

For the man who is satisfied with nothing less than full knowledge, Fig. 6 at *A*, *B*, and *C* shows a simple way of applying the cylinder test, and incidentally illustrates a device which will be found generally useful—a surface plate with one or more threaded holes for the standard of a dial test indicator. By tipping or shifting the square until the light crack disappears and noting the movement of the

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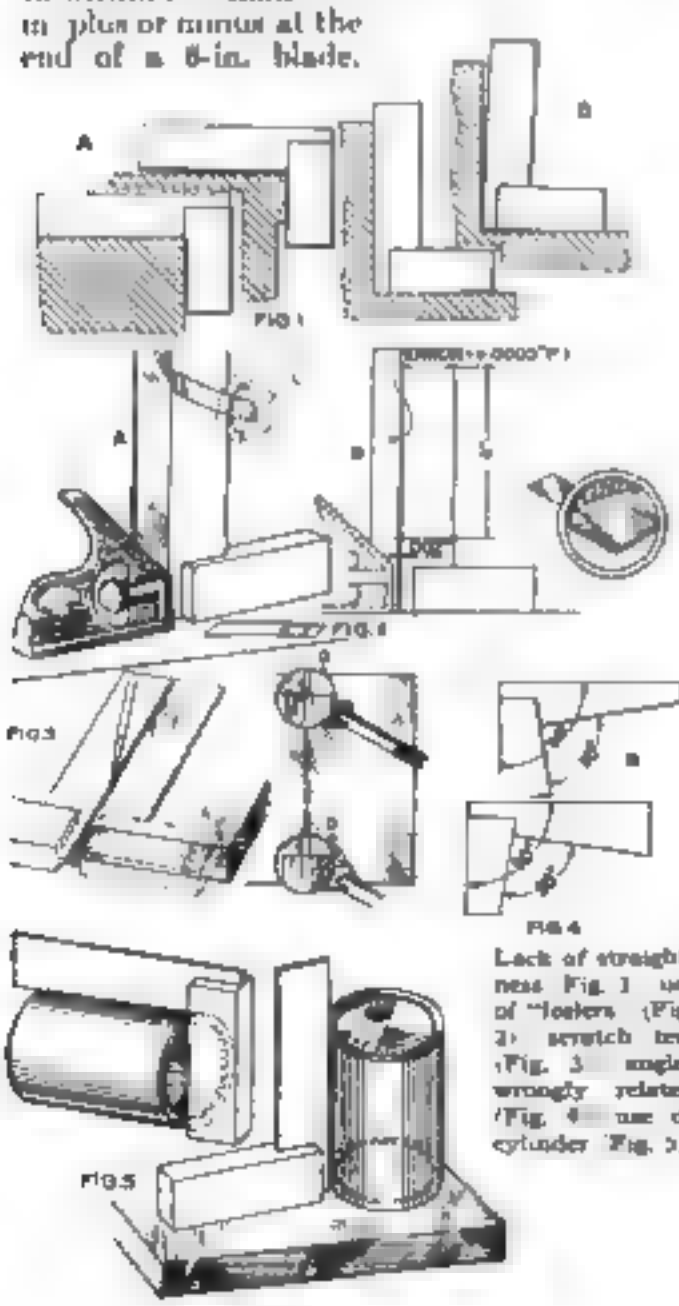
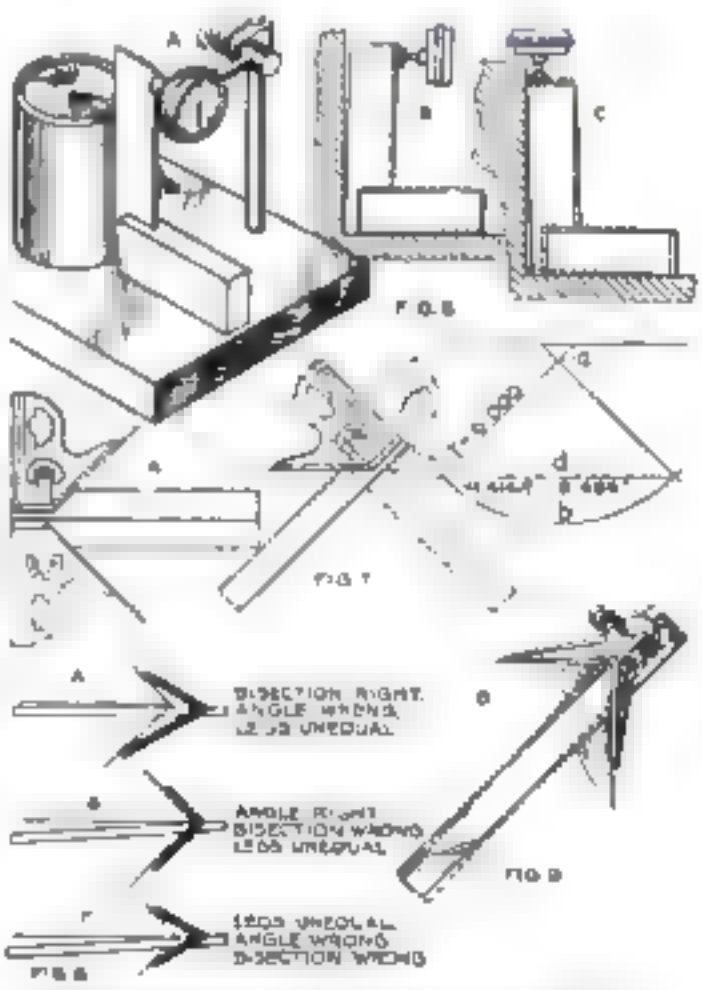


Lack of straightness, Fig. 1; use of "feelers" (Fig. 2); scratch test (Fig. 3); angles wrongly related (Fig. 4); use of cylinder (Fig. 5).



Indicator and cylinder (Fig. 6) combination heads (Fig. 7); chances of error (Fig. 8); line test (Fig. 9).

Simplifying *Your* Shopwork

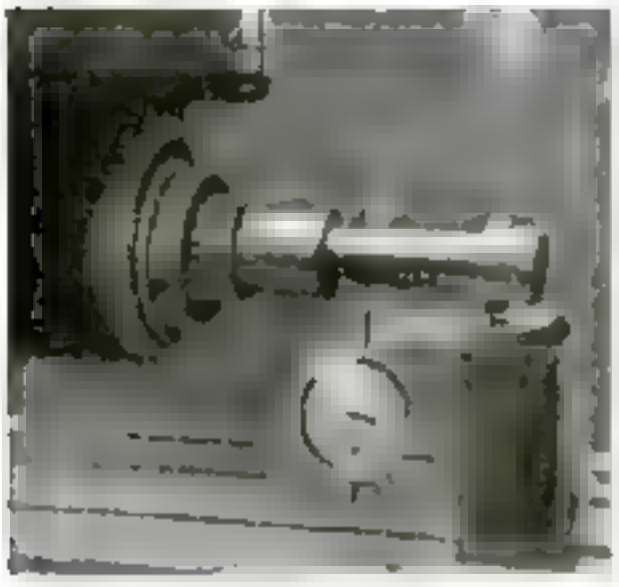


Fig. 1. Correcting a milling machine cutting arbor which is unsupported at the end.

MILLING arbors which are unsupported at their outer ends are subjected to severe strains, which sometimes bend them and cause the cutter to run out. It is a simple matter to correct the cutter arbor, provided it is not excessively damaged. With the arbor firmly seated in the machine spindle, as shown in Fig. 1, turn the spindle by hand and watch the indicator reading to discover the high side. Place a hardwood block vertically between the platen and the end of the arbor; then, with the high side down, raise the platen by means of the hand crank. At the same time note the amount of rise as shown on the graduated dial of the vertical feed, for this will indicate the amount of pressure exerted against the arbor and will be of use in the successive steps required to correct the arbor.

This method is to be preferred to centering an arbor in a lathe on centers, since the damage is repaired in a manner similar to the way the injury occurred, that is, the process is virtually a reversal of the one that caused the damage. It also leaves the shank undisturbed. —O. S. MARSHALL.

Old Bill *Says*—

REMEMBER that a long shaft expands a little when being turned because of the heat, so the tail center should be loosened and oiled at every cut.

Have you thought to oil your vise lately?

Sometimes less speed and more feed is better than less feed and more speed.

When adding fractions it's usually better to convert them to decimals.

Power hack saw blades make good "hold downs" for small work in the shaper.

Boring with the tool upside down at the back of a hole sometimes eliminates chatter because there is no tendency to lift the spindle from its bearings.

When you finish using a surface plate, put on its wooden cover.

BECOMING tired of the makeshift sometimes used to hold a lamp on a lathe when it is necessary to have it close to the work, the writer designed the holder shown in Fig. 2. It is cheap, simple, and quickly made; and it proved so satisfactory that it was soon applied to other machine tools.

The holder consists of a heavy dead-soft copper wire attached to the lamp socket and incased in a screen door spring, which is set into a hole in the stand. The wire is fastened to the lamp socket by winding it a couple of times around the lamp body; it may be attached

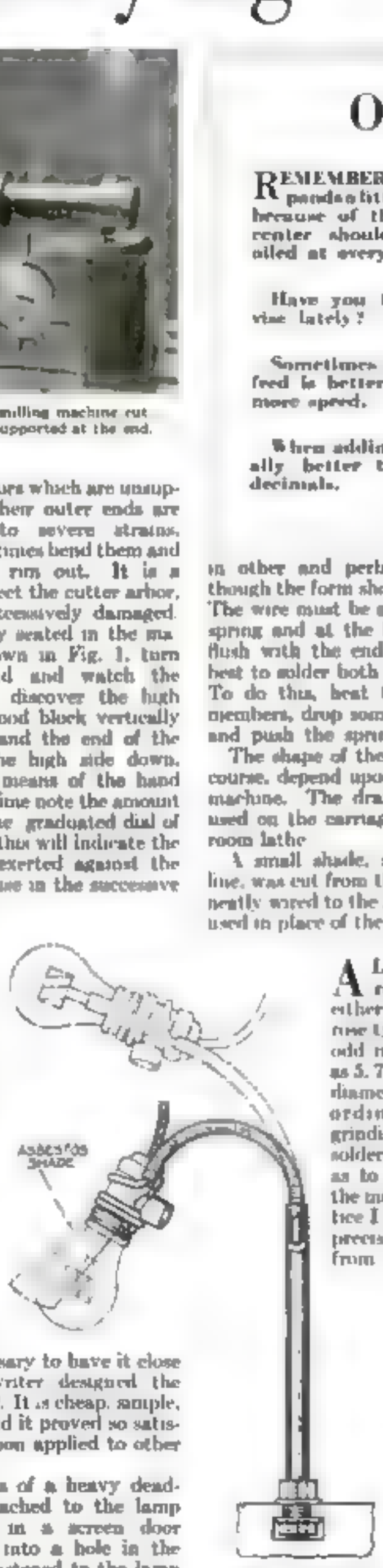


Fig. 2. Flexible lamp holder for machines which is easily made.

on other and perhaps better ways, although the form shown gave good service. The wire must be a free sliding fit in the spring and at the foot end it should be flush with the end of the spring. It is best to solder both together in their seat. To do this, heat the ends of all three members, drop some solder into the seat, and push the spring and wire in place.

The shape of the stand or foot will, of course, depend upon the kind and size of machine. The drawing shows the form used on the carriage of an ordinary tool room lathe.

A small shade, shown by the dotted line, was cut from thin sheet asbestos and neatly wired to the socket. It is generally used in place of the regular shade. H. S.

A LARGE number of reamers used today, of either the chucking or the rose type, are made with an odd number of teeth, such as 5, 7, or 9, according to the diameter of the tool. The ordinary procedure for grinding these is to pour solder in one of the flutes so as to get a center line for the micrometers. This practice I do not recommend for precision, for I have found from test that the reamers

Fig. 3. Reamer with odd teeth as prepared for grinding.

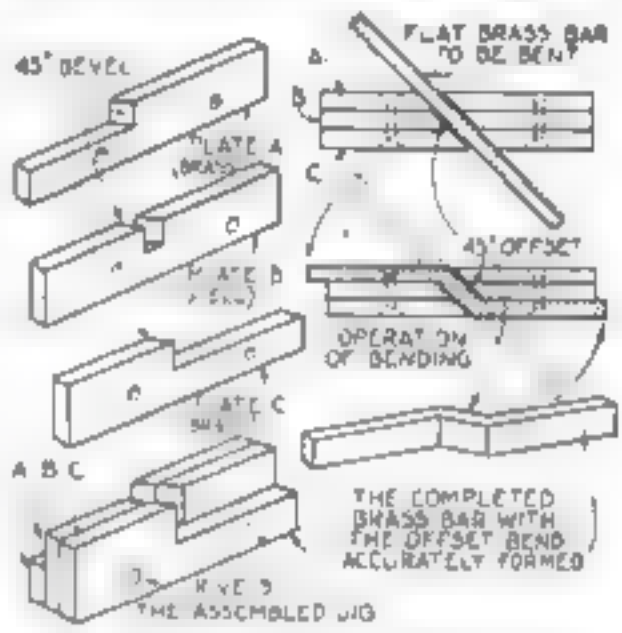


Fig. 4. Inexpensive jig for making offset bends by hand in a number of small flat brass bars.

may actually be from .0004 to .0005 in. oversize, although the micrometer reading shows the exact size. The error is due to the fact that the grinding wheel removes the soft material faster than the steel. The difference is likely to be more pronounced with high-speed steel reamers. This trouble will not be experienced, however, if a piece of drill rod is soldered in the flute as indicated in Fig. 3 for a size that will "make" when in the flute about .001 in. over the required finished diameter. HECTOR J. CHAMBERLAND.

FIGURE 4 explains the construction of a jig to form offset bends in a large number of flat brass bar pieces. The stock was 1/4

(Continued on page 115)

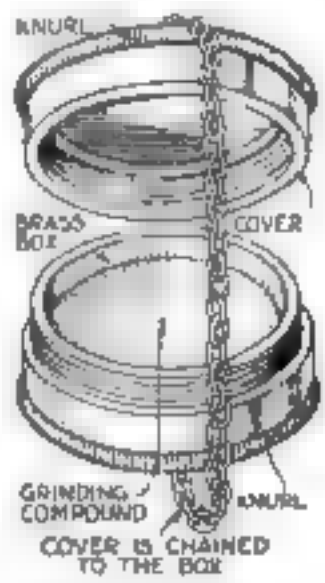


Fig. 5. Convenient and economical container for abrasives.

Settling the Question of Accuracy

Where assembled parts must fit correctly, their measurement should always be checked with tools of the highest quality to prevent costly mistakes.

It is with an understanding of these requirements that Brown & Sharpe has long supplied mechanics with tools of a high standard of accuracy. Confidence in the reliability of these tools among mechanics the world over has been built upon years of satisfactory use.

Where angles and square surfaces are to be checked the Brown & Sharpe Combination Set No. 425 will have hundreds of uses. This is but one of over 2300 useful tools described in Small Tool Catalog No. 31. Ask your hardware dealer for a copy or send to us. Address Dept P. S., Brown & Sharpe Mfg. Co., Providence, R. I., U. S. A.

B·S

"WORLD'S STANDARD OF ACCURACY"

BROWN & SHARPE TOOLS

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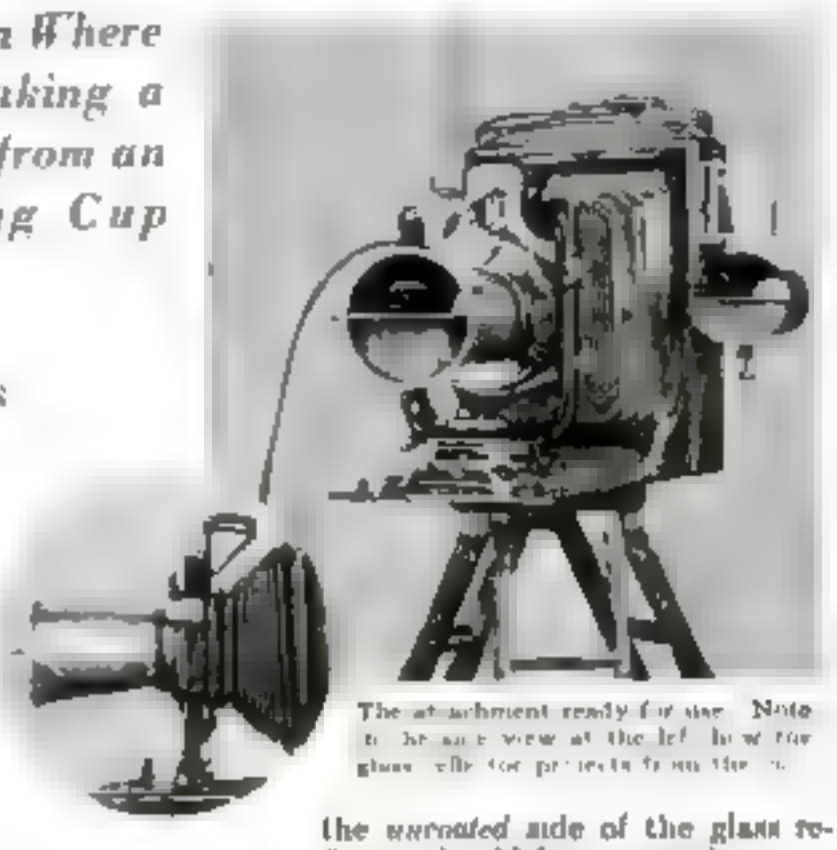
Photographing Reflections

You Can Do It Even Where None Exists by Making a Camera Attachment from an Aluminum Drinking Cup

By

JACK SUSSMAN



The attachment ready for use. Note at the left how the glass will be protected from the

BY MAKING a reflector attachment for your camera, you can take pictures with clear and realistic reflections on a dry day and in locations where it would otherwise be impossible to obtain such views.

For example, the foreground of the accompanying illustration which shows two dancers is in reality a pile of rocks; and the view of Grant's Tomb, as reflected on the pavement of Riverside Drive, New York, was taken on a dry day.

The reflecting device can be made to fit any camera. The one illustrated was prepared from an ordinary aluminum drinking cup with the bottom cut out. The cup is 1¾ in. in diameter at the base to fit a Carl Zeiss 6½-in. lens; it is about 3 in. in diameter at the mouth and 3 in. long.

After obtaining a suitable cup or making a substitute from any available sheet metal, paint the inside black. Take an unexposed glass photographic negative and cut it to fit snugly in the exact center of the cup. It should be sufficiently longer than the full length of the cup so that the glass will extend outside the mouth of the cup for ¾ in. When the attachment is in position on the camera, the *unsilvered* side of the glass reflector should face upward.

Next cut a piece of cardboard to close and seal the lower half of the cup, and fasten it in place. Cover the thin edge of the glass where it extends from the mouth of the cup with a narrow strip of black gummed paper. The attachment is then ready to be placed on the lens.

To make a photograph it is necessary to bring the base of the original object and the base of the image, as reflected in the ground glass, as closely together as possible. Make the exposure with the diaphragm wide open.

While a graflex gives the best results, pictures taken with the average hand camera are satisfactory, provided a tripod is used. It will be noted that on the camera illustrated there is an additional attachment in the form of a sunshade reflecting finder. This was added so that the camera could be used, if necessary, without a tripod.

Two views taken with the reflector—Grant's Tomb, New York, photographed on a dry day but appearing as if reflected in wet pavement, and dancers taken where there were rocks in the foreground.

Everlasting Beauty

GUARDS THESE ROOF-TREES

Johns-Manville Asbestos Shingles mean Permanent Protection from Fire, Weather and Time

THIS beautiful home, roofed with Johns-Manville Rigid Asbestos Shingles, enjoys the beauty of a colorful roof which blends perfectly with its picturesque surroundings. It proves what every architect and builder knows—that upon the colorful beauty of the roof depends the character of your house. Velvety greens—autumn reds—mellow grays—there is a Johns-Manville roof to blend with every house design to meet every home-owner's desires.

And the colorful distinction of Johns-Manville Asbestos Shingles will last forever. Time does not touch them! Weather will not wear them out, nor penetrate their sturdy, thick protection. Fire cannot harm them. Roofing expense is ended for all time. You cannot afford to be without the lifetime of roofing beauty and protection found in Johns-Manville Shingles.

Look At Your Roof Today!

And for old homes as well as new! Thousands of houses are finding new beauty each year when re-roofed with Johns-Manville Asbestos Shingles *laid right over the old shingles.* Think of the satisfaction of knowing that you'll never have to worry about your roof again. Johns-Manville Asbestos Shingles end roofing expense. Let your local Johns-Manville Dealer tell you how *little* it will cost you to beautify and protect your home with these everlasting asbestos shingles.

Small houses, too, may be beautiful and protected by the use of colorful roofs of Johns-Manville Asbestos Shingles.

This delightful home is located at Oak Road Beach, Cleveland, Ohio. Its roof of J-M Asbestos Shingles is beautiful and everlasting.

Study These Homes

Successive owners of these houses will enjoy permanent beauty and protection from fire and weather. This is so because their roofs are of Johns-Manville Asbestos Shingles. A Certificate of Registration goes with every genuine J-M Asbestos Shingle Roof.

What "Made by J-M" Means

Johns-Manville Asbestos Shingles bear the "J-M" trade-mark—the hall-mark of quality of the world authority on Asbestos and its products. J-M Asbestos Brake Lining makes motoring safer for millions of car owners. J-M Built-up Asbestos Roofs guard office buildings and factories from coast to coast. Throughout industry "Johns-Manville" packings, insulations and fireproof building materials are famed for their unfailing service and quality. Write today for our booklet, the "New Book of Roofs."

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RIGID ASBESTOS SHINGLES

How to Shape an Eight-Sided Tapered Stand

By E. E. ERICSON

2. When the piece has been tapered square up the octagons at both ends by measuring from each corner a distance equal to half diagonal as shown below

1. Square up stock to size given and mark by the half-inch gauge shown at the left. Next gauge diagonals as shown on what is to be the smaller end as shown at left. Draw a line from the diagonal on each of these gauge lines to the [illegible] as at the right

3. Drive two fine nails through a thin piece of wood [illegible] with the corner just inside by the inside and the other [illegible] to the edge of the stock. Move the gauge along [illegible] keep for two [illegible]

4. A drawknife or a hatchet may be used to remove the surplus wood but do not cut too deeply. Smooth the surfaces with a plane [illegible] to the lines drawn with the homemade gage

5. An octagonal base can be made from two pieces of wood for example 1 in. and ¾ in. thick. Bevel the edges of both as shown at the right. Give the thicker piece a little more bevel than the thinner

6. The completed stand as made for a table lamp. If intended for a pedestal an octagonal toppiece of larger dimensions than the base should be added. The same principles govern all octagonal woodwork

Performance or....?

How do you select tools—by the nice bright appearance they make in the dealer's window, or do you consider carefully the basic qualifications of tool performance? After all you can't judge the merits of tools by the polish alone. You have to be sure that the balance and feel of the tools are suited to your individual needs, that the workmanship insures you against repairs and replacements, that the quality of material used is a guarantee of long life and satisfactory service.

But how, you ask, can the temper of the steel, the grade of the wood, the quality of the workmanship be ascertained? Take the advice of the experienced carpenter when he says "Nothing equals experience in fine tool making." For 60 years the Millers Falls Company has been making fine tools, improving the quality whenever the quality could be improved, bettering the design whenever the design could be bettered until its reputation for the best is recognized everywhere among those who know and use good tools.

The new Hand Tool Catalog contains complete descriptions of twelve major tool lines including:

Braces . Bit Extensions . Hack Saw Blades . Mitre Boxes . Automatic Tools . Levels . Auger Bits and Expansive Bits . Hand and Breast Drills . Hack Saw Frames . Planes . Nail Sets and Punches . New Electric Toolshop.

The new Electric Tool Catalog contains details and specifications of:

Electric Drills and Hole Saws . Electric Screw Drivers . Electric Bench and Pedestal Grinders . Wire Wheel Brushes and Grinding Wheels . Electric Hammers . Portable Grinders and Disc-Sanders.

When you need *Good* Tools MILLERS FALLS TOOLS **Turn to MILLERS FALLS**

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Your Shadow Stays Behind

While You Walk Off and Join Your Audience—A New Magical Illusion

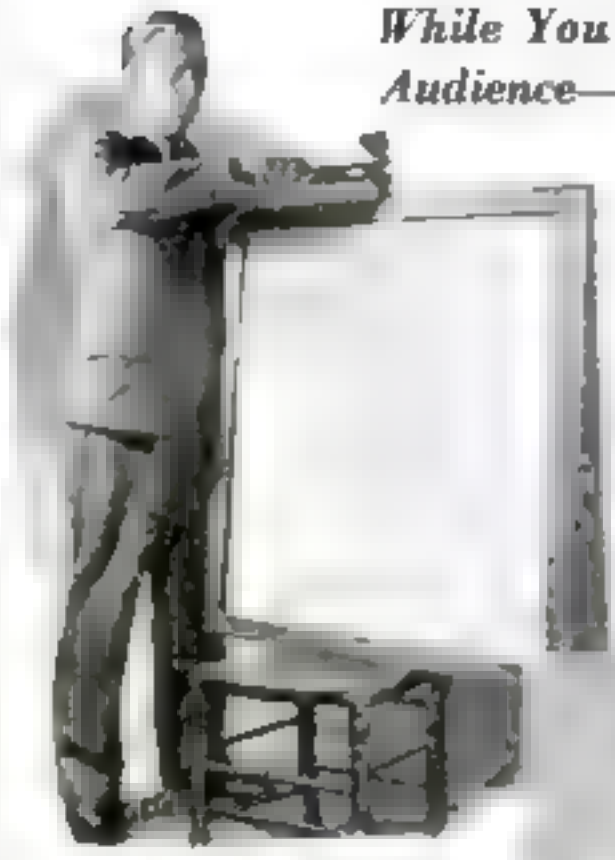


Fig. 1. Tacking and stretching the square of muslin on the wooden frame.

Fig. 2. The luminous paint will not alter the appearance of the muslin if applied without streaks or brush marks.

By GEORGE S. GREENE

THE phantom shadow sometimes known as "walking away from your shadow" is one of the newest tricks for the amateur magician.

In presenting a simplified form of the illusion, the performer on a dark stage or in a dark room allows his shadow to be thrown on a cloth screen by the aid of a strong light. When the light is turned off the performer walks away from the screen and takes a seat in the audience, although his shadow still remains very clear on the screen. As in many other successful tricks, the method is entirely scientific.

To build the screen, use four pieces of wood ¾ by 2 by 30 in. Miter the corners and fasten them together with flat angle irons. On this frame stretch and tack lightweight white muslin, as in Fig. 1.

With a flat brush, give the screen a coat of white luminous paint. The paint must be put on quickly and evenly (Fig. 2).

Luminous paint is sold in 2-oz. jars, which is a sufficient quantity. For those who wish to make their own paint, a suitable formula is as follows: Grind together in a mortar 6 parts prepared barium sulphate, 6 parts prepared calcium carbonate, 12 parts white zinc sulphide, and 30 parts luminous calcium sulphide. Add this mixture to 40 parts made up of 25 parts pure copal varnish, 5 parts pure turpentine, and 10 parts pure linseed oil.

After the luminous paint has been applied, the screen must dry thoroughly. Hooks for hanging it are then installed and the screen is suspended on wires from the ceiling or from a rope stretched across the room. Place a strong light (arc light or high-power incandescent lamp in a reflector) behind the screen, as in Fig. 3, and have the room lights switched off.

Now for the trial performance, which should be private. Pose directly behind the screen, without moving, for a minute (Fig. 4). Have your assistant turn out the light; then step immediately from behind the screen and pass around to the front. You will see a clear shadow of yourself.

Innovations in the form of "shadowgraphs" (see the hand in Fig. 3) may be added to make the exhibition last longer.

Fig. 3. The performer's shadow is thrown on the screen by means of a strong light.

Fig. 4. The shadow as seen by the audience. It persists after the performer moves away.

How to Read Blueprints

Hints to Help You Grasp Quickly Just What a Draftsman Means

By CHARLES M. HORTON

A draftsman simply makes pictures of an object as if viewed from different angles.

MOSTLY, after you've caught the hang of it, you read blueprints with as little mental effort as you dress in the morning. First you must catch the hang of it, though

Having had the fact drummed into you at school that a mechanical drawing is a series of pictures of a solid—a machine or table or whatnot—shown on a single plane, and that every kind of line has its own peculiar significance, you've got a half hitch on the "big idea" already

Usually three views or pictures will suffice to bring out all that is necessary of the thing to be made—side view, front elevation, and plan (or top view). Sometimes two views will do it; sometimes a dozen views are necessary to show the thing clearly. It all depends.

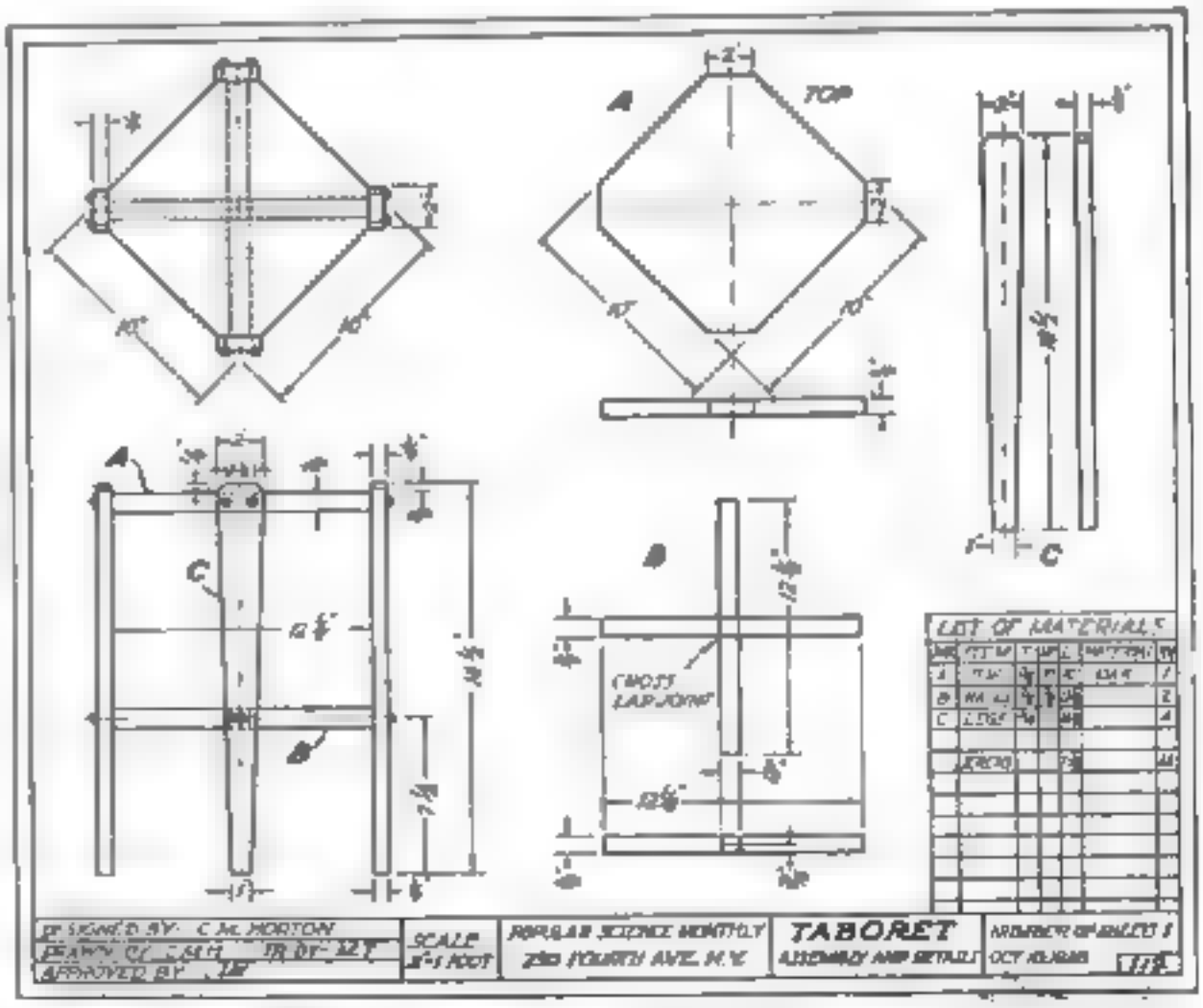
A plan view might well be called a bird's-eye view of the thing, as if you were looking down on it from directly above, while the elevations are what the name implies—views of the object as you stand on the "ground" and look at it from the front and from the side.

You can't go very far wrong if you'll visualize these truths about the draftsman's trade Draftsmen do but walk around and fly over a thing in their mind's eye and then make pictures of what they see

It is your job to do this, too, when striving to read a blueprint. All you have to do is to tie the different points in the several views together to form a single picture—the thing itself And that, as I say, after you once get the knack of it, comes as easy as reading a comic strip.

A youngster in my neighborhood recently came to me with a blueprint He had a hunch he could make the thing if only he could get a few hints on reading blueprints. His name was Myron Joseph Something, but the gang called him Mary Joseph. He was, and is, a bright kid, handy and ambitious with tools. I looked at the blueprint. It was a taboret.

"See these fine dot and dash lines, running through *(Continued on page 106)*



A sample shop drawing or blueprint considerably reduced in size. It shows a commonly used method of listing the materials or parts and their sizes and also a typical form of title strip.

DREAMING

won't start you in Aviation, young man. It takes Action—

Begin Now! Send for This Book

CLOSE your eyes. Can you picture the time when you have completed your solo-flight and your friends rush out to congratulate you? Or, when you have qualified as a Master Mechanic and are directing the work of others? Or, when you have made a place for yourself in this big, new, rapidly growing industry? Every young man with a spark of ambition can see his goal in his dreams. But the young man who is wise takes action at once to make his dreams come true.

Where to Start

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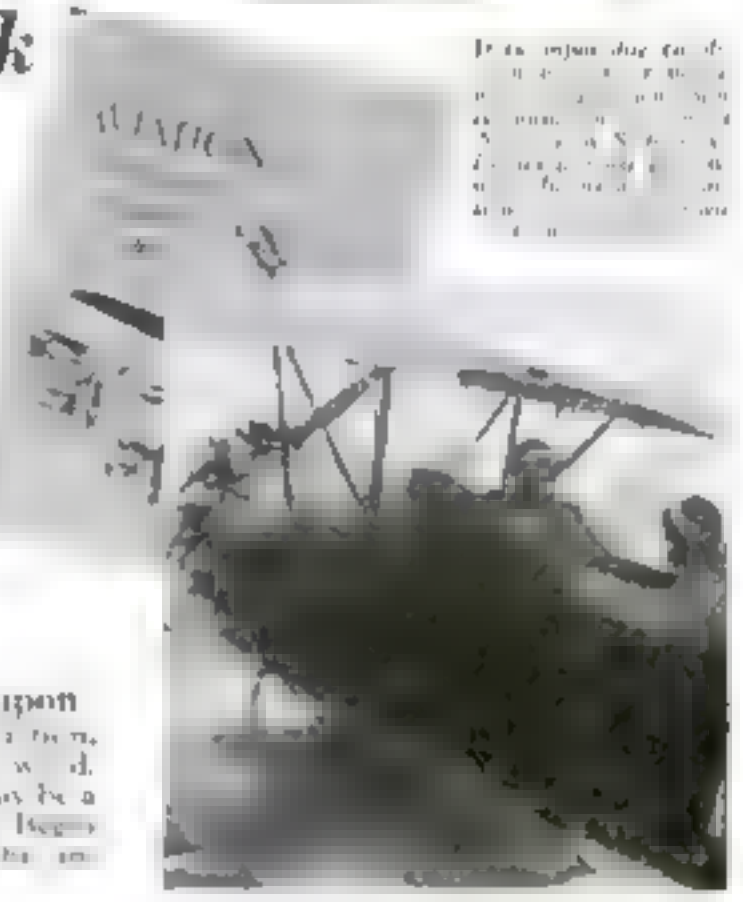

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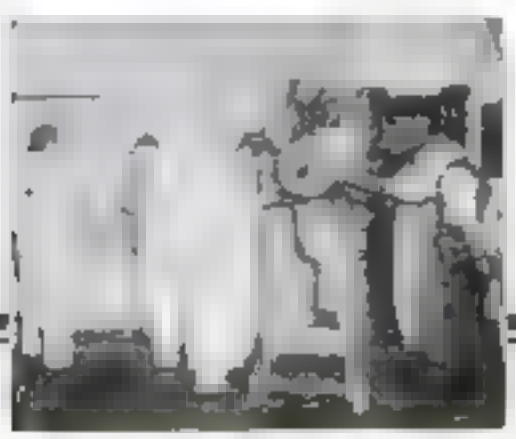
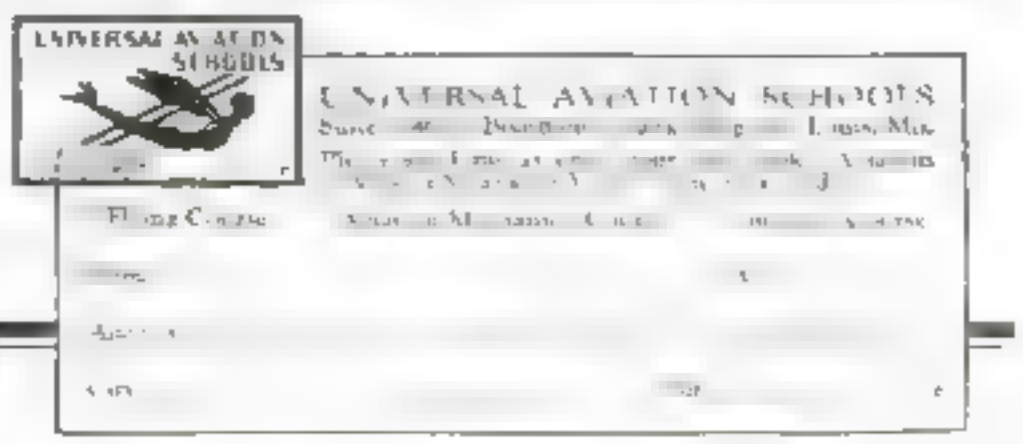




How to Read Blueprints

(Continued from page 105)

the center of the different views?" I began. "They're center lines. Practically every drawing or blueprint has those. They help the pattern maker, machinist, and woodworker lay out his work."

"Yes, sir," said Mary Joseph.

"See these neat little dotted lines running across the plan view? They mean that the part shown at that particular place cannot in reality be seen on the taboret when it is made. Something hides them—in this case, the top of the taboret. But it is necessary to show them, just the same, so a cabinetmaker will know just what they are.

"The heavy, solid lines, as you can guess, are the taboret itself. You see it has four legs, each one slightly tapered two inches wide at the top and one inch wide at the bottom as marked."

"I could make them," commented Mary Joseph.

"CERTAINLY you could." I encouraged. "This is a clear drawing because the draftsman has made both assembly and detail pictures. Look here—to the left of the sheet are the top and the front views—the assembly, or assembled, views, as they are called. Then, to the right of them, are drawings of the taboret top; below it, drawings of the crosspieces that brace the legs; farther over are drawings of the leg itself a flat view and an edge view of it as well."

I went on to explain that in making a mechanical drawing, the usual procedure is to make one view, generally a front elevation, like this front elevation of the taboret, then make other views from it, like the plan view, which is the drawing above the elevation of the taboret. Two views of the taboret served sufficiently to bring out what was necessary in this case. The details at the side represent the parts of the taboret before it is completely put together. Having made the pieces as detailed, it is easy to glue and screw them together.

"And the measurements are shown by the figures in those lines with the arrows on the ends?" Mary Joseph asked.

"Yes, those are dimension lines. They show you the size to make every part.

"A draftsman," I went on, "has to make pictures as if looking at an object from different angles, in order to see for himself just how things are going together. The way he does this is by a process known as projection, and projection is what the word implies—a point on one view is carried across or up to the plan or other elevation. This is done with drafting instruments—T-square and triangles.

"This blueprint shows two views of the taboret, with the details drawn off to one side. Where should you begin to read it? Anywhere—the place where your eye is inclined to fall and linger most. That place is apt to be the front elevation. You see a picture here that you recognize—a taboret.

"From this picture, this front elevation, your eye travels upward, for you have a hunch that the picture shown above in some way belongs with the lower picture. It does. It is a bird's-eye view of the taboret and shows it from above.

"Suppose this taboret were complicated and yet a third picture had to be shown to make it clear. Chances are the third picture would be a side elevation, shown to the right of the front elevation, and you would then see clearly how the taboret would look from this third angle.

The finished taboret, which should be compared carefully with the drawings.

"It does not matter much where you begin. What does matter is that from a given point on a blueprint, you send your eye across or upward to the other views, in order to ascertain just how long the thing is, or how wide, or how thick—if it has thickness."

"I begin to understand now," said Mary Joseph, a finger on the plan view of the taboret. "This picture shows that the taboret is square and not round. If it was round, it would show a circle here."

"The keystone of the arch!" I exclaimed, tickled at her ready grasp of the subject. "That's the sure ticket. You've got the whole secret!

"That projection of the eye from one view to the next can be aided," I went on, "by means of the T-square or the angles, if the blueprint be fastened to a drafting board. If the blueprint is just lying loosely on a table, you can get help in the work of 'following' over or up by means of dividers. Sometimes the dimension lines themselves help; sometimes you rely simply on the accuracy of your eye. But it's simple.

"LOOK at the taboret once more. You'll want to know how thick the top is, and how wide it is across the narrow distance. These dimensions, in this particular blueprint, show in two places—the assembly view and the detail on the top, *A*. It is ¾ in. thick, and across from one side to the other, it is 10 in.

"Take any point on the blueprint," I continued, desiring to drive home further lessons before Mary Joseph, who was getting impatient, grabbed the blueprint and ran. "Take the topmost, topmost corner of the leg, in the front elevation. You want to know how the leg looks, looking at it *(Continued on page 107)*

How to Read Blueprints

(Continued from page 106)

from the top, so you may know how wide a stick of hardwood to use for the legs. Well, you see it, don't you? You let your eye run up to the plan view, following a straight line. What do you see? You see that the leg is rectangular, not round, and that it is fastened to the taboret with two screws. Again, take the cross lines a short ways up from the bottom of the taboret in the elevation. That could be, from this front view, almost anything a shelf, a simple crosspiece. But it isn't either How do you know this? By again looking at the upper picture You see dotted lines which reveal to you that this is a cross brace made out of two sticks, and if you will let your eye drift to the detail *B*, you will see how to make this before assembling it into the taboret as a whole."

MARY JOSEPH was looking at the bottom of the blueprint

"What does it mean, where it says 'Scale three inches equal one foot'?"

I'd completely forgotten about that And it was important My explanation was substantially this

Drawings are made in correct proportion That is, when the taboret was finished in the wood its general lines would be exactly similar to those in the blueprint But some things are so large the draftsman can't show them on an ordinary size sheet of paper. Whole boats are drawn on paper, but if they were shown full size, a sheet of paper as long as a city block and longer would be necessary That is, of course, out of the question. So the draftsman reduces the thing to be made to a scale suitable for handling on paper

IF A thing is ten feet high when made, he will make it ten inches high on his drawing, and the scale of that drawing will be one inch to the foot. Otherwise it will be an exact counterpart of the unit itself. The blueprint of the taboret was drawn to a scale of three inches to the foot. That means that three inches being one quarter of twelve inches the drawing of the taboret is one quarter natural size. Everything about it in the drawing is in correct proportion That helps the mechanic to visualize his work he'll know the proportions before the thing itself is completed.

"I'd like to go now," said Mary Joseph taking up the blueprint, "I can make this easily. Thank you, sir"

"I know you can," I responded. "Frequently it will require a little study of a blueprint before you are quite sure. Sometimes certain *facts* have to be dug out, especially where it is necessary to know how the *inside* of the thing looks like a blueprint of a steam engine cylinder But even in such drawings the story is told clearly by means of the various views"

"Yes, sir," said Mary Joseph, as he sped away, blueprint in hand.

Within two days he was back with the taboret itself and we compared it with the blueprint

Mary Joseph had done a good job.

Boy Builds a Gas-Station Model

Uses Cardboard, Sandpaper, Flour, Salt, Twigs, and Cheap Materials—Dyes a Towel to Represent Grass

By ROBERT J. SCHULTZ

Robert, who is 14, won the grand prize at a Boys' Hobby Fair conducted by the Rotary Club in Cincinnati, Ohio, with this miniature filling station.

IN MAKING the model of the gasoline filling station illustrated, only inexpensive and easily obtained materials were used.

The base of the model is 30 in. square. The six-sided main building and the corner columns were made of 1/8 in. thick bristol board, each piece being notched to interlock with the adjacent sides. A coating, which consisted of two parts of flour and one part of salt wet just sufficiently to make a paste, was applied; and the brick joints were formed by grooving with a knife. The brickwork was colored with red oil paint, and while still moist it was dusted with a powder obtained by crushing a red brick.

Half of a rubber ball was fastened to the top of the building, and both it and the canopy over the pump were covered with small rectangular pieces of No. 00 sandpaper and painted green to represent shingles. The bracket lanterns at the entrance of the building were formed from gelatin capsules such as are used by druggists. These were fastened to lead brackets and striped in black to represent the iron frames. The windows were made of a transparent wrapping material and painted to represent stained glass.

The gasoline pumps are round dowel sticks filed into octagon shape. The pump handles are finishing nails bent S-shaped. The hoses are round shoe laces.

The tree trunks, well fulcrum and pole, and the rustic bridge are dried tree branches and twigs. Seven Lombardy poplar trees were made by tying strips of air fern to the twigs forming their trunks. For the maple trees and hedges a denser air fern was used. The evergreen trees are air moss and the grass is a Turkish bath towel dyed green.

The drive and walks were made by gluing No. 3 sandpaper to the baseboards and coating it with a very thin paste of Portland cement and water. The well consists of small stones laid up in salt and flour paste around a 1½-in. round mailing tube, the whole being painted with thin cement. The water is represented by a mirror, and the ducks were modeled from white soap. The automobiles are metal toys.

How to Make a Neat Wrought-Iron Bracket

WHILE originally designed to support a heavy bird cage, the simple and attractive wrought-iron swinging bracket illustrated can be used for hanging a fern basket, electric light fixture, or any similar article, the total weight of which is not more than fifteen pounds.

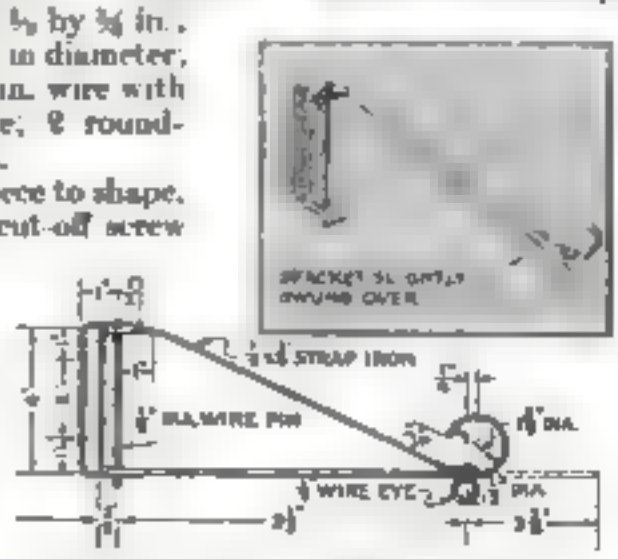
The material required is as follows: 3 ft. of strap iron, about ½ by ⅜ in., 6 in. of iron wire, ½ in. in diameter, 1 iron screw eye of ¼-in. wire with a ½ in. diameter eye, 2 round-head iron wood screws.

Bend the bracket piece to shape, and rivet it with the cut-off screw eye as shown. Make sure that the two right angle bends are true before riveting. Form the scroll bend after riveting.

Next drill the holes for the ½-in. hinge pin, keeping the pin parallel to the back of the bracket. Bend and drill the fixed hanger, the legs of which must be a snug fit over the bracket, with enough friction to prevent the bracket from swinging too freely.

The hinge pin may have a bead peened on it, or an eye bent to retain it in position, or, more simply, just a right angle bend. Do not rivet or otherwise retain the hinge pin in position until after the screws fastening the fixed hanger on to the wall have been put in, as otherwise these screws cannot be reached with the screw driver.

The iron may be finished in dull black paint, or given an antique finish with hammered high lights.—W. E. PATRICK, JR.



This light swinging bracket forms an excellent support for a bird cage or a basket of ferns.

Blueprints for Your Home Workshop

OUR blueprints can be obtained for 25 cents a sheet. In some cases there are two or three sheets to one subject. The blueprints are complete in themselves, but if you wish the corresponding back issue of the magazine in which the project was described in detail, it can be had for 25 cents additional so long as copies are available. Other subjects besides those below are to be had; send a stamped envelope for the complete list

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Magic Crosses

How to Whittle Two Curious 12-Block Wooden Puzzles

By ARTHUR L. SMITH

There is a world of fun in block puzzles for the man or boy who is handy at whittling.

A WOODEN puzzle easy to make and a favorite with many whittlers consists of twelve ½ in. square blocks. Usually six are 3 in. in length and six of varying lengths from 1½ to 2 in.

In the puzzles here described the first consists of six 3-in. blocks and six 1½-in. The different cuts are illustrated, and a solid block is shown scaled in quarter inches to indicate the size and position of the cuts. As all the cuts are ¼ in. deep and vary in length in ½-in. units, it should be no trouble to determine their size and position from the scale.

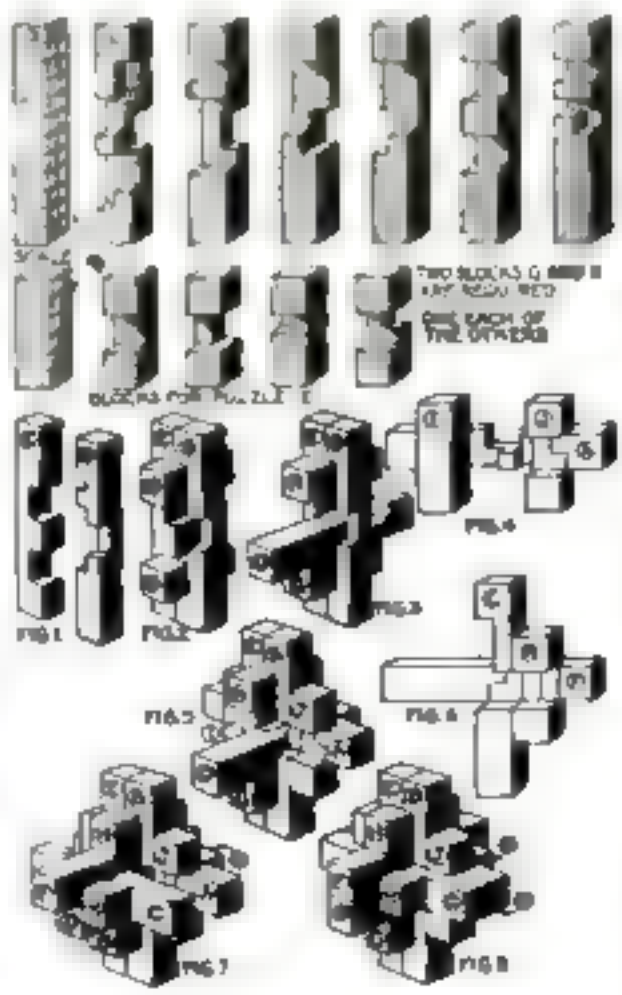
Some of the cuts are more elaborate than necessary to make this puzzle form. They are introduced not for the purpose of making the puzzle more intricate to solve but to suggest different ways of joining the blocks to those who become proficient enough to design original combinations. The chief pleasure in whittling these puzzles lies in designing the combination as you go along. Peculiar cuts often afford clues to the solver.

For the first puzzle, blocks *A*, *B*, *C*, *D*, *E*, *F*, *G*, *G*, *H*, *H*, *I*, and *J* are taken. *E* and *B* are brought facing each other (1). An *H* block is fitted in the ½-in. cut of *B* and a *G* in the lower ½-in. cut of *E*, before they are brought together (2). *H* and *G* will be held in position as shown. The *D* block is now pushed through the upper ½ in. square hole in such a position that its ½-in. central cut will engage the central projection of *E* and allow it to be lowered on *G* (3).

A combination of *A*, *I* and *J* blocks is formed (4) and fitted at the back of *E*, *B* so that the ½-in. projection of *A* will fit into a like space between *E* and *B*, with blocks *I* and *J* on the sides (5). The *A* block may be fitted into place first and *I* and *J* placed in position afterward, but the combination is shown to make it clear.

There is a wrong way to attach the *I* block and still allow the puzzle to be assembled, but it will be out of proportion. The *I* block must be so placed that it extends ½ in. on each side of *A*.

On the back of *D* there is a ½-in. space that cannot be seen in the illustration. Into this another *G* block is laid with its ½-in. cut uppermost. Then a combination of *F*, *H* and *C* is formed (6) and slid through the ½-in. square hole that extends through the cross. The combination is shown partly pushed through in the illustration No. 7, and No. 8 shows the puzzle assembled.



Puzzle I. The individual blocks, which are ½ inch square, and steps in assembling them.

ANOTHER way of making a puzzle of exactly the same shape and size is to use six ½ in. square blocks 3 in. long, four ½ in. square by 2 in. long, and two ½ in. square by 1½ in. long. That this can be done with four blocks each ½ in. longer than the 1½-in. blocks in the preceding case is something of a puzzle in itself. Perhaps it will do for a mental test, and those who satisfactorily explain it after a minute's deep thought will be entitled to a good rating.

The cuts of the blocks are illustrated on page 135 as in the former case with a scale. Note that the cuts on *O* and *P* are not perfectly central and that there is a difference between *R* and *S*. The ¼-in. cut on *O* is 1¼ in. from the top end and 1 in. from the lower end. On *P* the ¼-in. cut is 1¼ in. from the top end and 1½ in. from the lower. *R* and *S* form a pair, one right and the other left.

Blocks *K* and *L* are brought facing each other (1), but *U* and *T* are placed in position before *K* and *L* are brought together (2). As in the preceding puzzle, there is a wrong way to place *U*. It must project evenly ½ in. from each side of *K*, *L*. One of the *Q* blocks is used to bind *K*, *L*, and fits into a ½-in. space on *T* (3).

(Continued on page 130)

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THE home workshop enthusiast probably has learned from experience that there are many different kinds of steel and alloy steels, each adapted to a special purpose. A chrome vanadium steel auto spring will endure a punishment that would soon snap plain carbon steel leaves. A fifteen-percent chrome stock, which is the so-called "stainless steel," will not rust even when exposed to water. Nickel and molybdenum steels are earning the increasing respect of mechanics, while a tungsten steel tool will hold an edge under conditions that would ruin an ordinary tool. A few simple tests for quickly distinguishing between these alloys should therefore be of interest.

These tests closely follow the Johnson tests, named after the chemist who originated them. Solutions of sulphuric acid (oil of vitriol), nitric acid, ammonia and hydrogen peroxide are the only reagents necessary. All of these can be obtained at drug stores. The only apparatus required is a few test tubes, or lacking these some glass vials such as photographers' developers are sold in.

Prepare some fine drillings of the steel to be tested. In two of the test tubes place about one quarter as much water as they will hold. Then add about one third as much sulphuric acid. Drop an ordinary carpet tack (iron or steel) in one tube and an equivalent amount of the drillings in the other. For accurate results, the weights of metal placed in the two tubes should be about the same. Now place the two tubes in a dish of hot water for half an hour or until both steels are entirely in solution.

THE solution of the tack should be almost white in color and free from any black sediment. Hold the two tubes against the light and compare the tints. If the unknown (that is, the steel undergoing test) contained chromium, it will look distinctly green. Even so little as one third of one percent can be detected in this way. Nickel in steel also produces a green tint, but of a lighter, less distinctive shade. Now discard the solution containing the tack.

If the unknown contained tungsten, molybdenum, or any amount of phosphorus, a black, insoluble residue will remain in the bottom of the tube. The next step is to add ten drops of nitric acid very cautiously, as the solution is apt to boil out of the tube if the acid is added too rapidly. Then let the tube stand for five or ten minutes. A precipitate due to molybdenum or phosphorus will disappear, the latter with the characteristic odor of phosphine gas (also the odor of commercial calcium carbide), but tungsten shows up as a yellowish white sediment, which is easily recognized again when once seen. (Continued on page 126)

Wiring a Vase for Lights

A Workmanlike Way to Attach a Cluster Having Two Sockets and a Shade Support

By HAROLD P. STRAND

Mr. Strand utilized an antique glass vase in making this attractive electric table lamp.

ALMOST any large vase, jar, or jug of pleasing lines may be converted into a useful and ornamental electric lamp.

The simplest method of electrifying a vase is to use a ready-made, completely wired assembly unit. On its underside are three or four spring brass prongs which are compressed with the fingers and inserted in the opening in the top of the vase. For relatively small vases and large bottles a round block of rubber is sometimes pressed tightly into the opening instead of prongs. This method, while quick, has several drawbacks: only one bulb may be used and no real support for the shade is possible.

This article will describe a more permanent method of providing two sockets and a rigid support for any size shade. The materials required, which may be obtained at any well-stocked electrical supply store, are as follows: a teakwood or other suitable base, a piece of "running thread" ⅛-in. pipe a little longer than the vase, a spun brass plate to fit snugly over the top of the vase (or just inside if the top is irregular), a two-light cluster and a stem of a height that will support the shade where desired, a ⅛-in. lock nut, two pull-chain sockets, an attachment plug, and silk parallel cord.

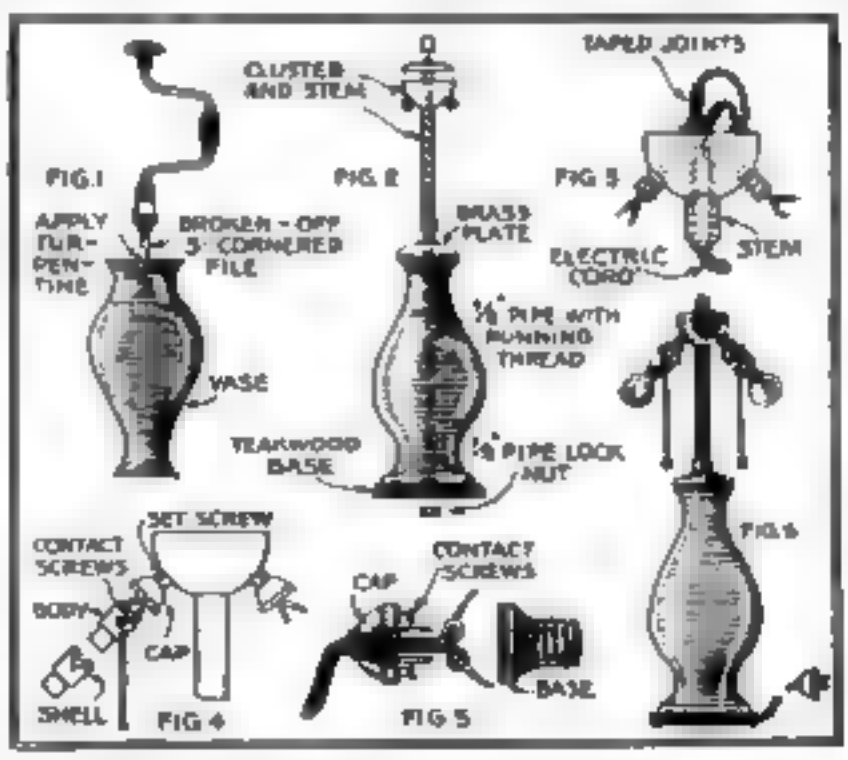
The first step, boring a hole in the bottom of the vase, is shown in Fig. 1. Some types of pottery are difficult to drill and require patience. A three-cornered file, broken off so as to leave a long, sharp point and edge, is usually effective when placed in a bit stock and used with a steady rotary motion and moderate pressure. Apply spirits of turpentine as a cutting and cooling fluid. Some have good luck with a common twist drill, if it is repeatedly resharpened. Be sure to avoid using too much pressure and being too hasty. When a hole is broken through, it may be enlarged and trued up with a round rat tail file wet with turpentine, placed in the bit stock, and turned to the *left*.

The spun brass plate should fit tightly as in Fig. 2. The pipe should be cut long enough to protrude about ¼ in. beyond the plate and ¼ in. through the thinner central section of the teakwood base. The lock nut is screwed on the lower end and the cluster stem is turned on the top until the whole unit is clamped together tightly. Before assembling, be sure there are no sharp edges on the inside of the pipe at either end.

THE cord should be pressed up from the bottom to the cluster on top, where the two conductors are separated for about 3 in. Halfway from the end of each of the separated wires, the copper is bared for about ½ in. On each of these bared spots a short piece of wire is tapped, as shown in Fig. 3, by baring the end of each piece and wrapping it tightly around the main wire. Solder the joints and tape them well. The two short taps are passed through one of the socket holes and the other two through the other hole. Fold the joints down carefully in the cluster body.

The pull-socket connection, shown in Fig. 4, is made as follows: Open the sockets by pressing on the shell at the point marked "press." Screw on the caps by loosening the set screws and turning them on the threaded

(Continued on page 111)



Steps in attaching a standard two-light cluster to a vase, jug, or jar. This method gives a firm support for a shade of any size.

Wiring a Vase

(Continued from page 112)

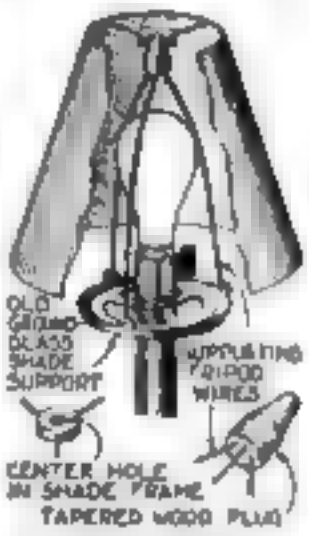
nozzles; then tighten the set screws. Bare the wires about ½ in. from where they come out, twist the strands in each wire to a solid cable, and place one wire under each contact screw on the socket, giving it only one turn *to the right*. Tighten the screws, trim off the excess copper wires, and replace the shell.

At the lower end of the lamp, pass the free end of the cord out of the hole usually found in the base for that purpose (one may be easily bored if none is found). Pull through all the slack cord. Separate the plug by pulling it apart and slip the cap over the cord. With a pocketknife separate the wires for about 2 in. and tie the Underwriters' knot, illustrated in Fig. 5. The ends then are bared and twisted tightly; each is tightened under a contact screw and the excess wire trimmed off.

Figure 6 shows the stand ready for the shade.

Support for Lamp Shade

MANY old-fashioned electric fixtures are still in use which have a metal ring for supporting a flaring glass shade or globe. A modern wire-frame lamp shade can be supported on such a fixture by making a wire tripod as shown. The lower ends of the three wires are bent to engage the screw holes in the old shade support, and the upper ends are driven into holes in a wooden plug.



Attaching a shade to an old style fixture.

Bench Magnifying Glass

FOR inspecting delicate bench work and performing operations on parts that are unusually minute, a magnifying glass inserted in the shade of the bench lamp as shown is of considerable assistance. The object being examined can be held close to the light and both hands are free, which is not the case when an ordinary reading glass or similar magnifier is used. The glass preferably should be about 1¼ in. in diameter.—JOSEPH BRACKETTS

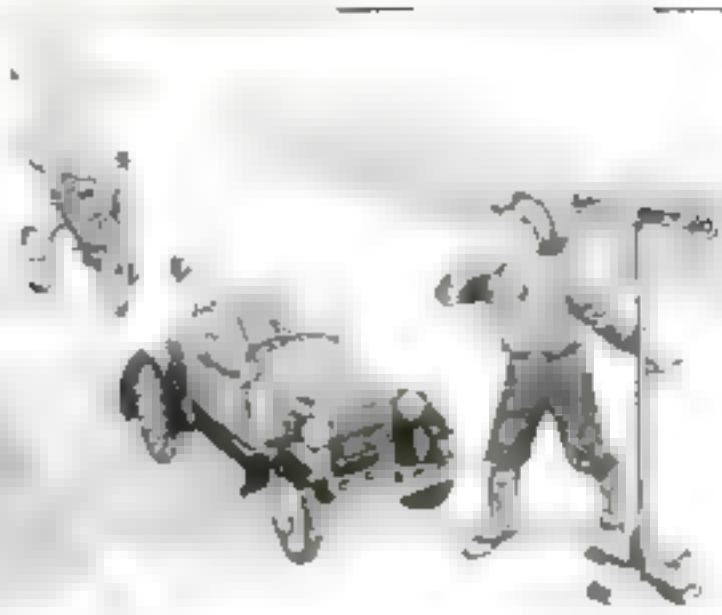
Lamp with magnifier inserted in shade

How to Cut Glass Square

IN CUTTING small sizes of clear glass for windows or picture frames, you will find a straightedge and an old newspaper form a convenient substitute for a glazier's square. Open up the newspaper and select the "column rule," or printed line between the last two columns, as a reference line. Make a pencil mark near the top of the page and exactly as far to the left of this line as the width desired to be cut. Do the same thing farther down.

Lay the good edge of the glass exactly to these marks. The printed rule will show through and indicate where the glass is to be cut. After cutting the pane to the right width, fit one of the sides to the horizontal rule beneath the running head of the newspaper, and trim off one end.

To cut the second end, make a single mark for the length of the pane, set the end to this mark, fit the long side to the horizontal rule, and cut to the vertical rule.—E. W. GOODWIN.



Playing traffic policeman is a game of which children never tire. It is doubly interesting with a stop-and-go signal that really works.

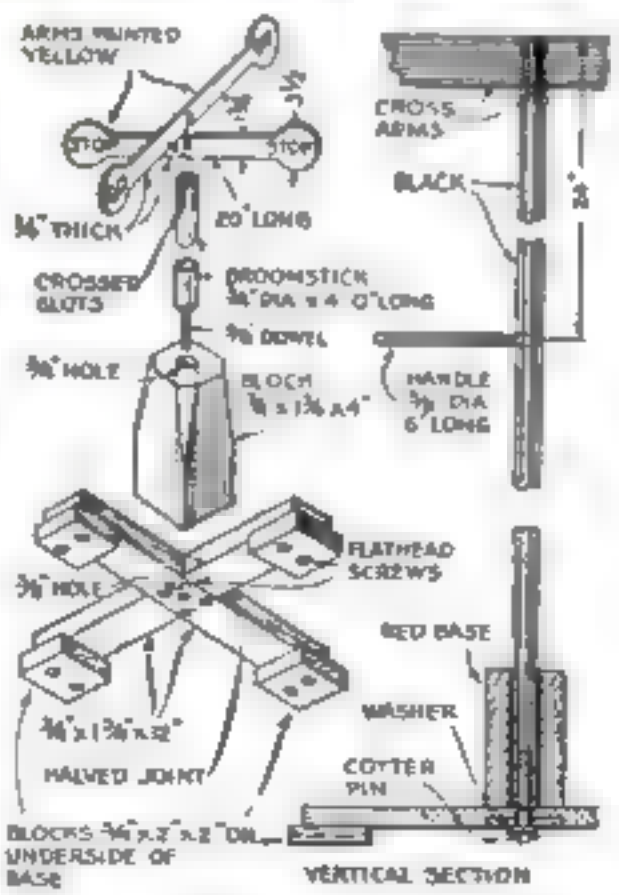
Revolving Toy Traffic Sign

How to Construct a Miniature Stop-and-Go Signal from a Broomstick and Scraps of Wood

By FRED W. MEGOW

TO MAKE this stop-and-go sign you will need the following materials: One pc. wood 1¼ by 1¾ by 4 in., 2 pcs. ⅝ by 1¾ by 12 in., 1 pc. ⅝ by 2 by 8 in. (for feet), 2 pcs. ⅜ by 3½ by 20 in., 1 pc. ¾ in. dia. by 48 in. (can be broomstick), 1 pc. ½ in. dia. by 6 in. (for handle), 1 pc. ⅜ in. dia. by 4½ in., 1 small cotter pin, 1 washer with ½-in. hole, 12 No. 10-1½-in. flathead bright screws.

On each end of the 1¾ by 1¾ by 4 in. piece draw diagonal lines to locate the center. With a No. 12 (⅝-in.) auger bit bore a hole all the way through. On one end measure ½ in. in from each corner and draw lines to guide in planing off the corners as shown.



A cross section through the toy and sketches to make clear how the members are assembled.

The two ⅝ by 1¾ by 12 in. pieces are to be fitted together with a half lap joint. Lay them side by side, locate the center, and square a line across both. Measure ⅜ in. on each side of the center line and square two more lines across both pieces. On each piece square the lines down each edge, and also gage or draw a line ⅜ in. from the top edge. With a saw make two cuts in each piece, being sure to cut on the inside of the line so as to have a good fit; then make a number of saw cuts in the waste wood, going only ¾ in. deep. With a chisel clean out the recess in each piece and glue the pieces together. Bore a ⅜-in. hole through the center of the cross and four ⅜-in. holes for screws.

On the ⅝ by 2 by 8 in. piece for the feet, square seven lines across one of the surfaces at 1-in. intervals. On the first, third, fifth, and seventh lines bore two ⅜-in. holes, each ⅜ in. from the edge. Cut off the blocks carefully on the remaining three lines and screw the four feet thus made on the ends of the cross-pieces. Let them project at least ⅜ in. in the front and ⅜ in. along the sides.

CUT of stiff paper 3½ in. wide and 20 in. long make a pattern for the revolving arms. First fold the paper in the middle and with compass and ruler draw the 3½-in. circle and the 1¾-in. wide arm. Cut on the lines, open the pattern, and use it to mark the wood.

Cut out the arms with a coping saw and sandpaper them smooth. Lay out and cut the center of each piece so as to form a half lap joint as indicated. Glue the joint and fasten it with a small brad or two.

In the end of the broomstick bore a ½-in. hole about 3 in. deep and glue in the 4½ in. long stick or dowel. Cut slots in the top of the broomstick as shown, using a saw and a very narrow chisel. Bore a ⅜-in. hole (Continued on page 115)

Toy Stop-and-Go Sign

(Continued from page 104)

into the broomstick 24 in. from the top end and glue in the handle. Now glue the arms into place and drive in two brads.

Place the lower end of the broomstick into the hole in the block the first piece made—and allow the small stick to pass through the hole in the crosspiece of the base. Fasten the block on the base with four screws. If the sign does not turn easily, use a wood file and sandpaper to ease the joint.

Put a washer on the stick projecting through the crosspieces and mark for a small hole, which should be drilled to receive a cotter pin or small nail. Then assemble the whole

Paint the sign like some real stop-and-go signal in your neighborhood. The main thing is either to have the word "Go" in green and "Stop" in red or to paint one pair of circles a solid green and the other a solid red, omitting the words.

First prize in the elementary woodworking division of a national contest for shop teachers conducted by the Educational Department of POPULAR SCIENCE MONTHLY was awarded to Mr. Megow, of the Thomas William Junior High School, Wyncote, Pa., for this toy stop-and-go signal. He submitted a series of fourteen drawings showing the construction step by step.

Patching Concrete Drives

The beveled strip reinforces the patch and keeps water from undermining the weak edge.

WHEN a curved cement driveway from the curb to the sidewalk is broken, repair it in the usual way and then run a beveled cement brace along the entire length, as shown, so the patch will not loosen.—CHARLES F. METZ.

Simplifying Shopwork

(Continued from page 90)

by ½ in., so the slot in the tool was cut ½ in. deep and slightly more than ¼ in. wide.

The tool is made up of plates *A*, *B*, and *C*. Plates *A* and *C*, which may be of brass, must be of the same thickness as the stock used. Plate *B* should be of tool steel and of the thickness necessary to provide the required amount of offset wanted, in this case *B* was ⅛ in. thick. The three parts of the tool should be held together by rivets countersunk on both ends, as all surfaces must be finished smooth.

The angle of the slot should not be nearer a right angle than 45 degrees and all cross cuts should be at the same angle. The slot in the core piece—plate *B*—is the hardest to make, but care and ingenuity should take care of that.

The bending is done between the jaws of the vise.—FRANCIS WILKIN.

A SATISFACTORY and economical way of handling valve grinding compound is indicated in Fig. 5. Small brass boxes with screw tops are used and plainly marked as to the grade of compound. These are kept filled by the tool room attendant and given out by him as needed in exchange for a tool check. As the compound is always ready and in clean condition, there is no waste.—V. A. LUCAS.

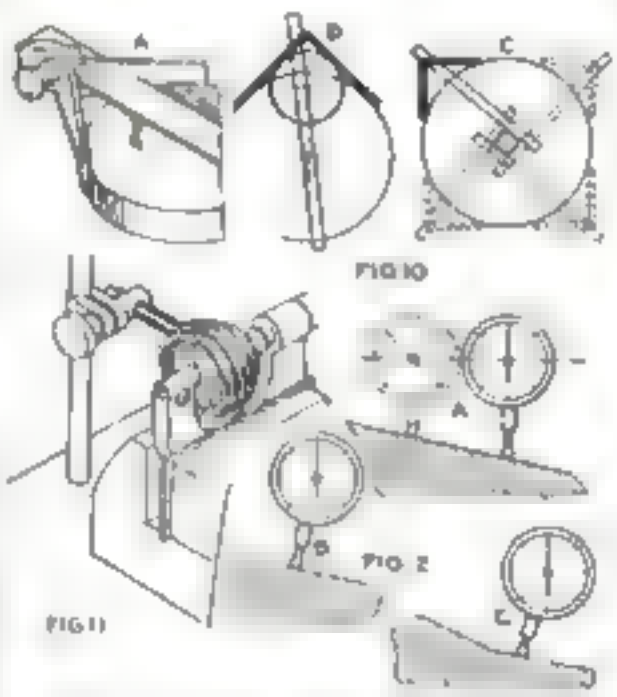
How to Test Your Squares

(Continued from page 9)

pointer, the exact amount of deviation is established. We then have a definite quantity which can be made the basis of an allowance in any work calling for exceptional accuracy.

In addition to the right angle, the 45° angle exists in every combination-square head. It is also used in the form of a special V-head on such tools, largely for finding the centers of cylindrical work. One way to test the 45° angle of the square head is by an adaptation of the parallel-line method illustrated at *A* in Fig. 7. This, however, requires an accurate right angle at one corner of the plate, hence the trigonometrical method is more convenient. The same plate is used as for testing the 90° angle. Two fine lines, intersecting near the edge at *a*, are drawn. With the help of a magnifying glass, a very fine prick mark is made for the divider point at the intersection. Arc *b* is then drawn, radius *r* being some exact multiple of 1 in. Distance *d*, as ascertained with dividers and magnifying glass, should then be 1.414 times *r*. The error is doubled, so that a deviation of .0025 in. or over can be detected.

In examining the V-head, it is necessary to distinguish between the angle formed by the



Testing and using a V-head (Fig. 10) ways to verify and set a dial indicator (Figs. 11 and 12)

V, which should be 90°, the bisection of the angle by the blade for work of a rating which is less than the length of the legs *a* and the length of the legs, which must be equal for finding the location of the center of round work of large diameter. As will be seen from the diagrams *A*, *B*, and *C* of Fig. 8, these three elements have nothing in common, as each may be wrong and yet the remaining two right.

If the angle of the V-head and of the plate corner, Fig. 8, happen to be very nearly an exact 90°, then the parallel-line test will check all elements at once. In many instances, there will be an appreciable difference, and then this test for bisection becomes unreliable, as may be seen.

It is therefore better to test the bisection of the angle and the centering capacity of the tool by the use of disks with a very fine point at the center as at *A* in Fig. 10. Here it must be kept in mind that two disks are necessary to make the test complete, for reasons appearing at *B*.

A way of finding the center of a cylindrical part with an accurate centering square is illustrated at *C*. By applying the square at four points around the circle and scratching a fine line each time, it is easy to locate the center of a circle that will be tangent to all the lines and therefore will represent the center of the work.

(Continued on page 1

How to Test Your Squares

(Continued from page 116)

In any instrument where measurement is mainly a matter of linear division, as a scale or vernier caliper, there is practically no possibility of a "lead error." Engine-divided etched scales, such as are used in all modern tools, are so accurate that the error is measurable only with the costliest precision instruments. On the other hand, a scale cannot be read with anything like the accuracy of a micrometer. At least this is true of ordinary mechanics' tools, although it does not apply to high-precision measuring machines, which use a microscopic linear scale of spider-thread fineness and wonderful accuracy.

SIMILAR reasoning applies to protractors made by any maker of repute. To check any of them it is sufficient to examine the right angle at one or both positions, and the parallelism of the blade and head at zero. As the possible error is virtually confined to the relation of the edges to the angular scale, it is certain that any intermediate division will be right if the relation is correct at 0 and 90°. The examination of the right angle is the same as in a square.

Many mechanics never check their dial test indicators, probably because they do not consider them a regular measuring instrument. Yet in checking tapers, for instance, where differences of up to ¼ in. or more must frequently be measured, it becomes important to know how nearly right your indicator is. Therefore it pays to check it occasionally against a micrometer, going over the entire range and stopping at irregular intervals to compare the reading. Figure 11 shows a good way to hold both tools for this test in a convenient manner to insure accurate readings.

Dial test indicators should not be expected to have all of the accuracy of micrometers, but they should be right within .0004 in. in their total range. If your indicator ever does require repair or adjustment, your one best bet—as with most fine instruments—is to send it to the maker and let him "worry about it."

Many "off" readings are the result of wrongly using the indicator. An indicator should never be applied as at *A* in Fig. 12, for the double reason that it is liable to be strained and that the reading will be unreliable. The correct application is at right angles, as at *B*.

If the surface under test has two or more angles and it is not practicable to reset the indicator, it should be set as at *C*. Particular care in this respect is required in testing cams, as it is very easy to set the indicator so that it cannot work properly at some points.

Again, eternal vigilance is the price of success, and the work we do with our tools cannot be more accurate than the tools themselves. If you would work "right to the scratch," be sure that *all* of your tools are in perfect condition.

This is the seventh in a series of articles by Mr. Simon on shop problems of interest to the machinist and toolmaker. In his next article, which is scheduled for early publication, he discusses the use of optical aids in the shop and shows how mechanics can save themselves much eyestrain and worry and at the same time turn out more accurate work.

WHEN mounting a new grinding wheel, test it for flaws by sounding it with a small wrench. it may have been damaged after leaving the factory. Have the diamond reset occasionally; unless it has a sharp point, the wheel will give an unsatisfactory finish. See that the belt driving the wheel spindle is clean and tight enough to prevent any loss of power. Before sizing a piece on centers, shut off the water and wipe the work dry.—H. J. C.

Fixing Composition Roof Shingles

Paste this Home Workshop Reference Sheet, including the head above, in your scrapbook in the section marked *roofs*. (July, 1929, POPULAR SCIENCE MONTHLY.)

What is the best way to stop leaks in so-called composition or asphalt shingles?

THESE shingles, if of good quality, are durable and need little attention, but the lighter and poorer grades are rather difficult to repair. Carefully raise any loose shingles and paint under them with a good grade of asphalt paint or paint such as comes with roll roofing and is used to cement the laps. This will seal all but the poorest of composition shingle roofs and renew its life for years. Be careful however to apply the paint only where it will be covered by the shingles, or the job will be most unsightly.

How can one renew the slate or other surface finish of composition shingles which are worn or badly discolored?

USE one of the coatings manufactured for the purpose by some paint manufacturer of national reputation. If a preparation of this kind is unobtainable locally, mix the following for each 100 sq. ft. of roof to be renewed: 1 gal. turpentine asphaltum, 1 gal. bright red or green house paint, according to color of roof, and 1 qt. spirits of turpentine. Stir thoroughly and apply heavily. Do the painting on a very warm day, if possible, and allow at least sixty hours between coats. This treatment will renew the color and, by soaking into the felt base of the shingles, will restore their waterproof qualities.

What is the method of stopping leaks near the chimney, in valleys, or at flashings of a composition shingle roof?

ONE of the various roof cements may be applied with a putty knife or trowel, or a homemade preparation may be used: 1 qt. asphalt paint or any colored house paint matching the roof color, and enough asbestos plaster, obtainable from a plumber or steamfitter, to make a mixture of the consistency of putty.

Where shingles are curled badly, only a new roof will suffice, or the rather drastic method (when appearances are of no particular importance) of nailing them down flat and painting the entire roof with one of the renewers previously mentioned.

How is a new shingle inserted?

RAISE the shingle in the next course above and expose the nails. Remove these with either a good claw hammer or a pair of pliers. If this does not allow the damaged shingle to be removed, raise the next shingle above and remove these nails also. Take out the damaged shingle and insert a new one, replacing the nails with slightly longer ones to obtain a firm hold. If the sun does not cause the shingles above to flatten down, a blowtorch can be used sparingly and (Continued on page 119)

Composition Shingles

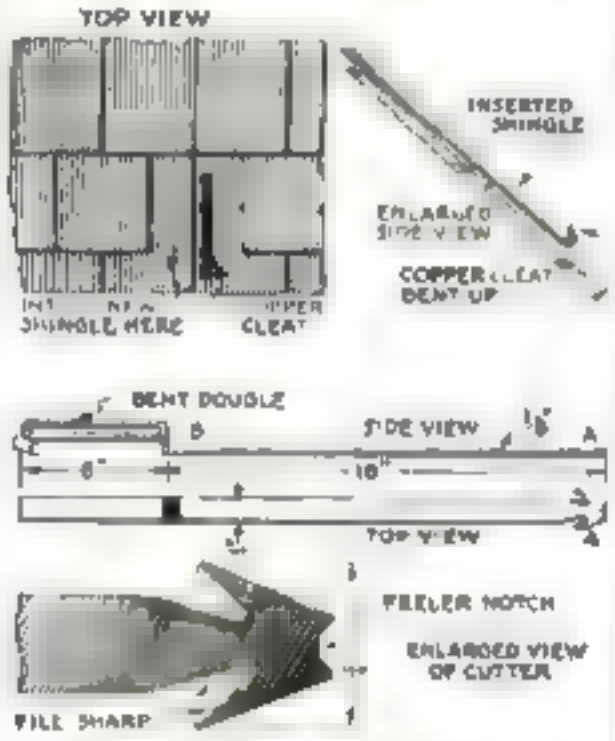
(Continued from page 118)

with the utmost care so as not to scorch the shingles or cause a fire. The heat will flatten them, but the sun will usually do the same in the course of a day or two.

The procedure for the repair of the so-called "patent" or locked joint shingle is much the same, although considerable patience is required in unloosening the locked ends or tabs so as not to damage the surrounding shingles. Usually, unless the roof leaks very badly or has been damaged by hail, wind, or fire, there is very little likelihood of anything happening to a roof of this character which will require the replacement of the entire roof for a number of years.

When a so-called asbestos or rigid shingle is damaged or blown off, how can it be replaced?

SHINGLES of this type rarely give trouble, but they are rather difficult to repair owing to their brittle nature. If leaks are extensive, it is best to engage a competent roofer to repair



Method of fastening a new rigid asbestos shingle in place, an easily made tool for removing nails

them. However, the roof cement used to repair asphalt shingles will seal leaks in these also.

When a shingle has to be replaced, the tool illustrated can be used to remove the nails by inserting it under the shingle (or slate), hooking lug *A* above the nail, and hitting shoulder *B* sharply with a hammer. This will cut the nails and allow the shingle to be removed.

The tool can be forged from a piece of ⅛ by 1 in. spring steel. The working end is arrow shaped with the barbs filed sharp. The end is hardened by heating it to a cherry red and cooling it suddenly in water. Bend the shoulder *B* up about 1 in. to form a shoulder to hit with the hammer. Double the handle end *C* for strength and as a backing for shoulder. Should it be impossible for any reason to cut a nail with this tool, use a nail cutting saw sold for the purpose.

If the shingles are of the diagonal type, insert a new storm nail (a small copper wire nail with large head) and slide the shingle up in place. Reset the storm nail and bend it as before; this will hold the shingle in place. When the shingles are of the standard rectangular style, mark where the bottom comes and use a copper cleat or a stiff wire fastened to project about 1 in. below the bottom of the shingle. Slide the shingle up into place and bend up the copper cleat.

Leaks can also be stopped in these roofs by sliding pieces of galvanized iron or copper under them in the vicinity of the leak, but do not let these pieces project and spoil the appearance of the roof.—C. W. Hunnicutt.

Building a Fast Yacht Model

(Continued from page 84)

The See Scout [illegible] geared for high speed

[illegible] ers to fever pitch in races like that below

Model in action. These duplicate [illegible] after the [illegible]

combination is a pine deck in a natural varnish finish, a mahogany or walnut rail, a white enameled topside, a red boot-topping, and a marine green bottom.

Between coats, while the paint is drying, the builder can make the fittings and spars. The mast and booms are made of clear, straight grained white pine or spruce, planed square to the required dimensions. The corners are then planed off to an octagonal shape, and finally the remaining corners are planed off, too, and sandpapered smooth and round. The spars should be varnished. A standard 1-pin brass ferrule and two pins are fitted at the bottom of the mast, as illustrated.

The mast step is made of mahogany or walnut and secured by means of No. 8-32 brass machine screws with adjusting nuts on top.

The rudderstock is made of 1-in. brass tubing slotted on one side with a hack saw to take the 16-gage brass rudder, which is then soldered on. The tiller is made of the same sheet brass, bent double and riveted or pinned to the rudderpost. Holes are drilled in the tiller for the sheet line hook. This permits the shortening of the lever arm to suit the pull on the tiller, which varies according to the wind pressures. The rudder, when completed and fitted in place, should be free to swing back and forth at the slightest pull on the tiller.

The chain plates are of sheet brass, bent and drilled as shown. The brass fittings may be polished with fine emery cloth and lacquered bright, or they may be nickel plated or, of course, painted.

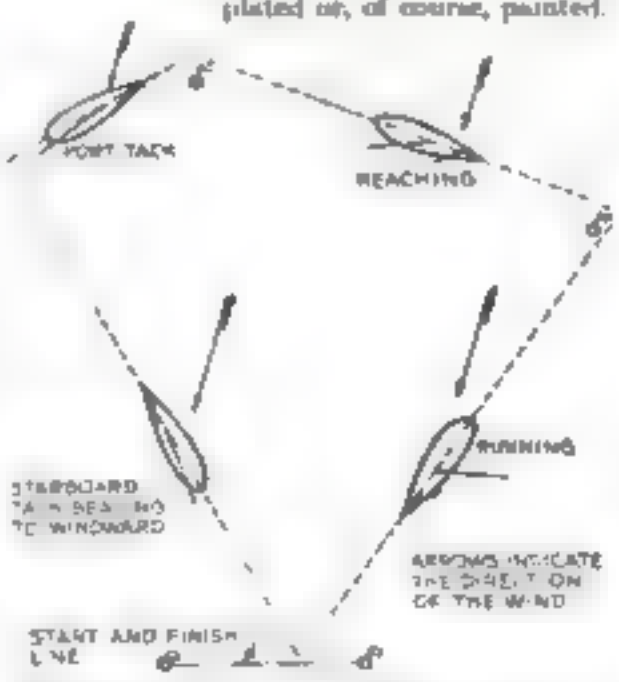
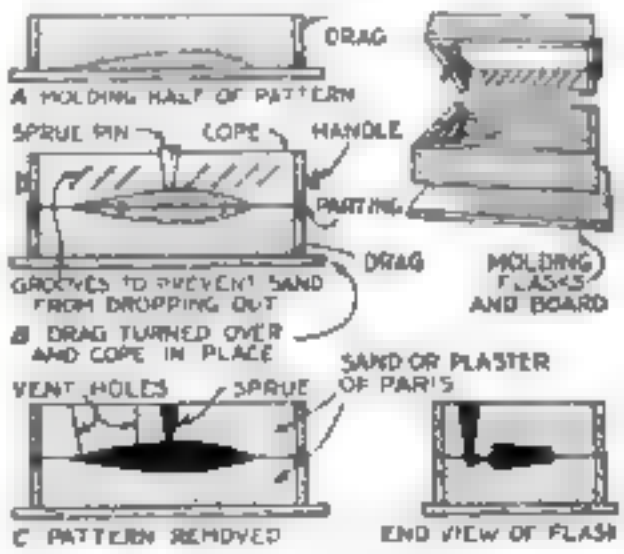


Diagram to explain the principles of sailing a model. Note the position of sails on each tack.

A simple gooseneck (that marked No. 1) can be made with brass ferrules and brass wire. Gooseneck No. 2 is very satisfactory but more difficult to make.

German silver wire is excellent for the stays, but brass wire also may be used. The stays should be tightly looped around the mast (30 in. above the deck, over fine cotton cord lashing, varnished in place so as not to slip down. Turnbuckles in the 1-in. size can be purchased from several supply firms. The jumper stay from the mast tip to the taffrail aft should be light cotton cord or fishline with a toggle adjustment. The toggles are made of celluloid, bone or hard maple with a small hole at each end in which the cord binds or grips when the pull is at an angle. These toggles permit of rapid adjustment.

To aid in keeping the sail flat and to prevent the boom from lifting, a sight spring or a rubber band is secured about 2 in. from the end of the boom to the mast step.



How the mold for the lead keel is prepared. Either sand or plaster of Paris may be used.

The jib sheet traveler may be made of brass wire (about No. 18 gage), bent as shown, with the eyes sufficiently large to take small oval-headed brass screws.

The sails may be made of Egyptian spinnaker cloth, balloon cloth, oiled silk, or high-grade rubber. Two-ounce spinnaker cloth is satisfactory and may be secured through any canvas dealer.

It is advisable to make full sized muslin patterns of the sails. In order that the weave may take the strain without stretching out of shape, it is essential that the leech (after edge) of both sails be par- (Continued on page 181)

A Fast Yacht Model

(Continued from page 120)

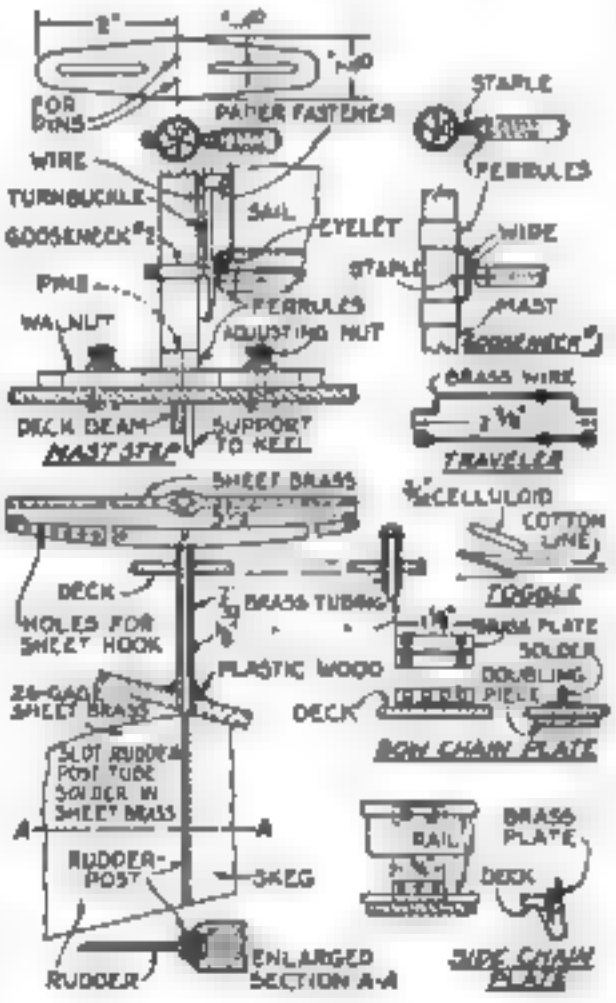
allel to the selvage edge of the cloth. Draw around the patterns with a sharp, soft pencil. This line represents the finished size of the sails, so a cutting line should be drawn ⅜ in. outside of the pattern to allow for a ¾-in. hem. Baste the hems carefully and, for the most satisfactory results, sew them on a machine with silk.

A triangular piece of celluloid is cemented and sewed inside the hem at the head of the mainsail to keep the corner flat. The batten pockets, which are sewed on, may be of tape with selvage edges or of the sailcloth (with the raw edges turned under). The outer ends of the pockets are left open until the celluloid or wood battens are inserted, and then these edges are closed with hand sewing.

To take the strain of the boat and thus prevent undue stretching of the sailcloth, a strong cotton draw string may be threaded through the hem at the luff (forward edge of the sails) and made fast at the corner eyelets. The draw string should be just taut enough to permit a full boat without puckers in the hem.

In each corner of the sails a metal eyelet is inserted with an eyelet punch, but the punch should not be used to make the preliminary holes or the eyelets might work out. The holes should be pierced or stretched open with an awl or bodkin. If an eyelet punch is not available, the holes may be buttonhole stitched.

The simplest method of attaching the sails



Details of mast step, rudder, two types of gooseneck, toggles, traveler, and chain plates.

to the mast is by lacing them with a needle and a linen thread through the hem of the sail and around the mast. A neater arrangement, and one which readily permits of dropping the sails, is to run a fine German silver wire fitted with a turnbuckle from the gooseneck to the mast tip. This arrangement is shown on the same detail drawings as gooseneck No. 2. The sails are attached to the wire by means of brass paper fasteners of the type indicated, these are pressed into the hem of the sail. It is advisable to fit two or three fine open hooks along the mast, into which the wire can be snapped to prevent its sagging from the mast.

In bending or securing the sails to the spars, they should not be stretched at all. Allow them to lie evenly (Continued on page 122)

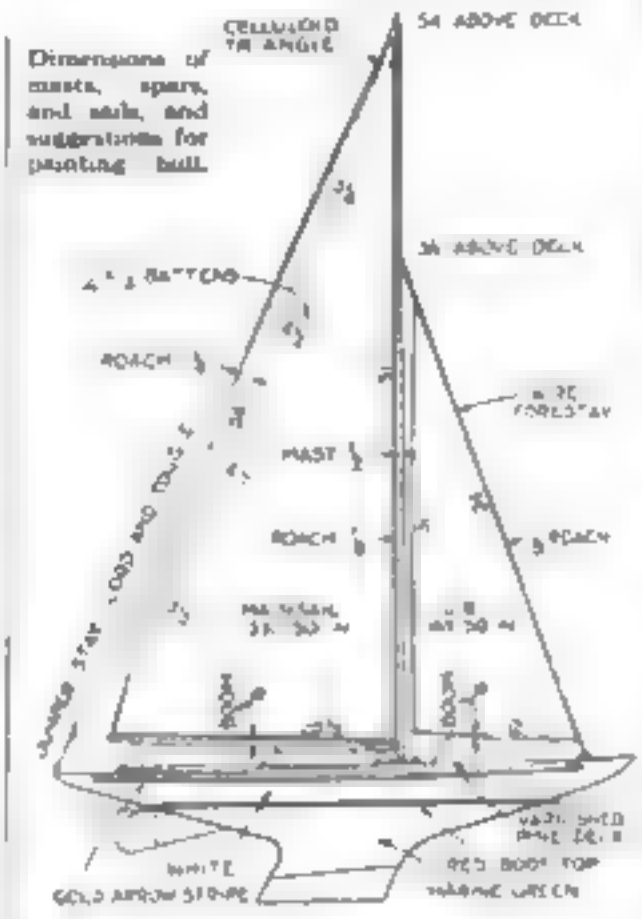
A Fast Yacht Model

(Continued from page 421)

and comfortably along the booms with the out-hauls easy

A small 2- or 3-in. silk American yacht ensign (or, less correctly, the American flag may be sewed to the cord jumper stay. If a model yacht club is organized and a club flag is adopted, a miniature of this may be flown from the mast tip. For club racing, a black racing number of the size and location directed in the rules of the Model Yacht Racing Association of America should be sewed to the main sail.

A stand for the model should be made. A simple one is constructed of a ½ by 7 by 14 in. plywood baseboard with an upright support at its center, the latter cut to the shape of the hull amidships and extending from the bottom



of the keel to the load water line. This center support should have felt glued to the narrow contact surface in order to protect the hull of the model. A hook locks the model securely to the stand as shown on page 86

It has been found convenient in transporting the model by automobile to clamp the base of the stand to the running board with cheap C-clamps. This does not necessitate unshipping the mast

Assuming that the model is now completely rigged, we are ready for the trial run. Models may be sailed from skiffs or rowboats, usually around a triangular course, or from bank to bank on inclosed ponds. For younger sailors, sand sailing is the better

No attempt can be made here to explain completely the principle and manipulations of yacht sailing. The diagrams on page 423 will assist in mastering the principles involved.

The embryo sailor should learn the rules and courtesies of yacht racing. Racing rules and other data helpful in organizing model yacht clubs may be obtained from the Model Yacht Racing Association of America, the secretary of which is A. W. Payne, 4733 Thirteenth St., N. W., Washington, D. C.

For further study of model yacht construction, reference should be made to the following books: *Build a Winning Model Yacht* by Thomas Moore, and *Miniature Boat Building* by Albert F. Leitch, which can be obtained for $1.50 and $3.00 respectively from the Book Department of POPULAR SCIENCE MONTHLY.

Simple Ways to Polish

(Continued from page 50)

powders are also much used for grinding and polishing. These materials are usually listed by number, and their particular uses are described in dealers' catalogues.

Machine polishing requires the use of a polishing head, which is an essential part of the metal worker's shop equipment. There are polishing wheels and buffs Fig. 5 of many kinds and shapes. Roughly, these may be divided into three classes leather wheels for the first polishings, cotton and buff wheels for the final polishings, and brush wheels for scratch brush finishing.

Thick walrus hide is a favorite material for polishing wheels. It may easily be turned into special shapes to fit certain work and polishes rapidly when charged with one of the compositions mentioned. Wooden wheels are sometimes covered with a band of leather. These

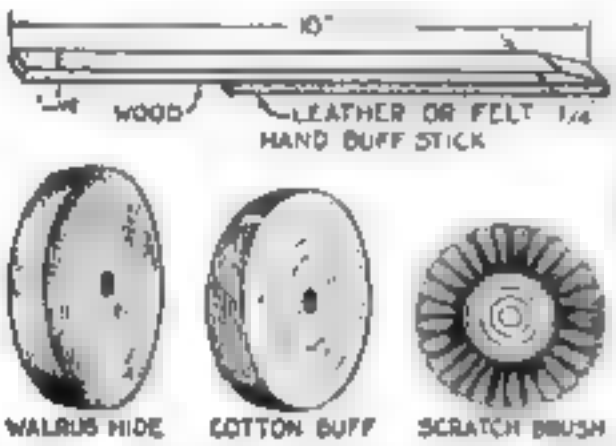


Fig. 5. How hand buff sticks are made, and three common types of wheels used for polishing.

have the advantage that they are stiff under the work and cut rapidly Either the leather band is charged with an abrasive composition or emery or carborundum powder is glued to the leather

Plain disks of pine or whitewood will make excellent polishing wheels if the edge of each is charged with a suitable abrasive. These may be made at home and are better if built up of several thicknesses of wood glued together with the grain crossing. I have often used a disk of thick pasteboard or strawboard to make a thin edged wheel for certain work, the edge being charged with a composition.

Wheels of wool felt are made in many diameters and thicknesses. Sometimes a ring of felt is placed on a wooden disk to make a stiffer wheel. Canvas buffs consist of a number of disks of stiff canvas stitched or quilted

Cotton buffs, which are used for the final high polish, are made of disks of muslin sewed together in the center or quilted. The wheel is stuck on the polishing spindle, which runs from 1,800 to 3,000 revolutions per minute, depending on the size of the wheels. The smaller the wheel, the higher the speed.

If your polishing head or motor is a small, high-speed one, you should use wheels of small diameter, say about 3 in.

The abrasive composition or cake is always applied to the underside of the wheel as it runs toward you. All work also is held up to the underside of the wheel (Fig. 5), it is dangerous to apply the work in any other way.

Wire and bristle scratch brush wheels are sometimes used to clean up work, but more often to give a beautiful silk or scratch brush finish. Wire wheels work more effectively in a thin trickle of soapy water.

Use great care in attempting to polish a chain of any kind. The chain should be wrapped around a length of wood and both ends fastened down securely

For certain small openings sawn in work, such as silver rings, lengths of cotton cord are charged with abrasive composition and the piece held in some sort of a vise while the charged string is worked back and forth.

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 8.

A Wood Turner's Tricks

(Continued from page 93)

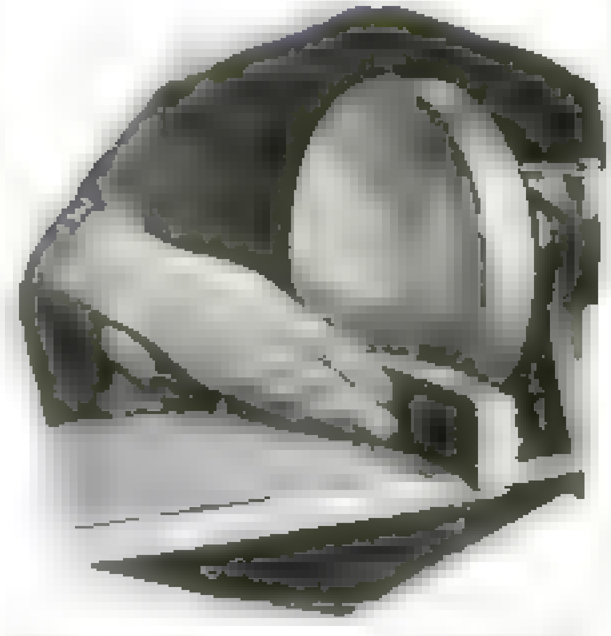


Fig. 7. How pieces such as the segments of the apron under a circular table top are sanded.

length desired. The subdivisions are arranged in a similar way. The spiral is drawn as at *A*.

If it is desired to lay out a double hollow spiral such as shown at the right in Fig. 8, proceed as in *B*, Fig. 6. In this case each of the major divisions is divided only in two. The first spiral line—that shown as shaded with short vertical strokes—starts on line *a*, goes to line *b* and circle 1, then to line *c* and circle 2, from there to line *d* and circle 3, and then to line *a* and circle 4. This makes one complete revolution. The second spiral line, which has been left white, starts at line *c* and goes to line *d* and circle 1, then to line *a* and circle 2, from there to line *b* and circle 3, and then to line *c* and circle 4.

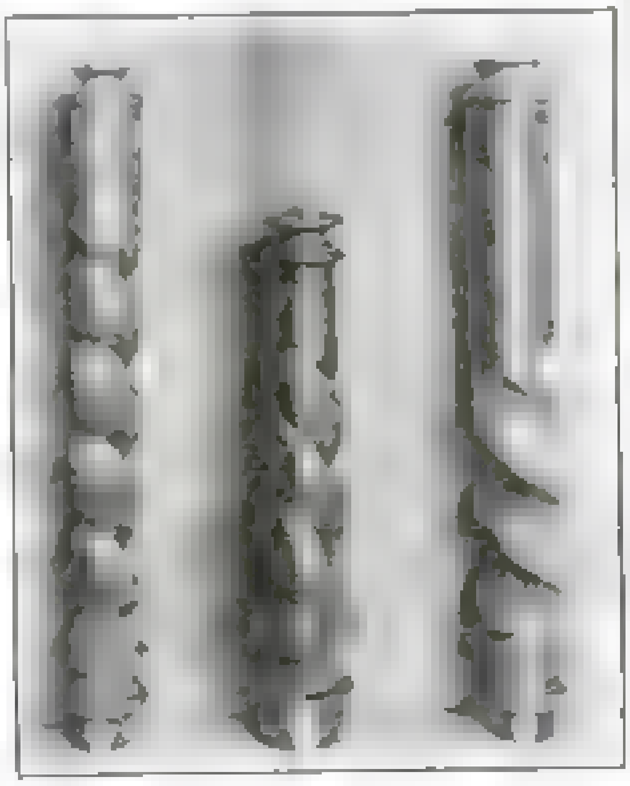


Fig. 8. Single spiral turning (left), tapered double spiral (center), hollow spiral (right).

The spiral lines in this case are about 1/8 in. wide. They may be laid out from a strip of heavy paper cut 3/8 in. wide and wrapped around the cylinder. The spiral lines on *B* form the ridge (see Fig. 8 at right).

The ropelike tapered double spiral shown in the center of Fig. 8 is laid out according to the method explained above (Fig. 6, *C*), but in this case, as in other double spirals, the major divisions are subdivided only in two.

The coffee table, Fig. 5, is a typical example of the use of spiral turning in furniture construction. The shaped stretchers cross each other and are joined with a cross-lap joint.

This concludes Mr. Hjorth's noteworthy series on wood turning.

Blueprints for Builders of Model Airplanes

MODEL airplane builders will find a wealth of material among the POPULAR SCIENCE MONTHLY blueprints. There are plans for many types of planes ranging from simple models to advanced scale models. In the latter class are Blueprints Nos. 89 and 90 (see page 109) of the famous Junkers low-wing monoplane *Bremen*. From these plans Ernest Code and Wilfred McEwen, of Victoria,

Model of the *Bremen*, built from POPULAR SCIENCE MONTHLY Blueprints Nos. 89 and 90.

British Columbia, constructed the *Bremen* model illustrated above. In a letter accompanying the photograph they said:

"We found the blueprints very easily understood and the method of construction appealed to us greatly. The performance in the air is commendable and the rigidity of construction withstands minor crack-ups very well. We are both ardent readers of your magazine and especially enjoy the aviation features and the model builders' department of blueprints."

The simplest of all our flying model blueprints is No. 88, a single-stick model. Others are Nos. 50, 69, 80, 87, 102, and 104.

Copying an Old Sea Chest

(Continued from page 87)

chest before fitting the cover and base. Screws and glue are used to fasten the bottom.

The cover is rather unusual. It is evidently a plank about 1¼ in. thick. Along the outside edge it is only ⅝ in. thick and has an overhang with a molded edge of the same dimensions. Some of the overhang over the hinges may have to be reduced to allow the cover to be opened wide; this depends upon the offset of the hinges used.

The iron trimmings on the original chest are handmade. The material is quite thin and appears to be hammered. The hinges, which are made of two strips of stock ¾ in. wide, pass underneath the cover. On the backboard each hinge extends down as far as the bottom. The hinges are placed 5½ in. in from the corners of the chest.

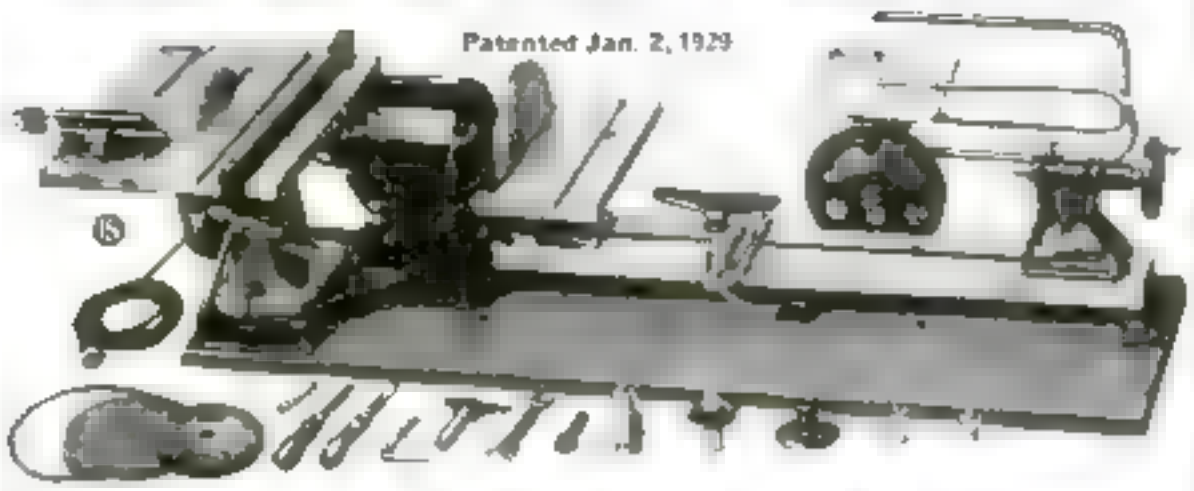
The handles also are handmade, and the bails are made of round stock with three knurls or knobs in the center. All the iron fittings are painted black. Ready-made hinges and handles may be used if an exact duplicate is not desired. An iron lock with a small escutcheon for the keyhole completes the fittings.

Whatever kind of stock you may use, it is well worth your while to sandpaper the chest inside and out as thoroughly as possible.

If your chest is made of white pine, it will look well finished with oil or one coat of white shellac and another of varnish will make a fine contrast with the black iron bands and trim. Sea chests sometimes were painted, and you may prefer to paint yours in an attractive color.

This is the third of a series of articles on early American furniture by Mr. Bryant, who is well known for his book, *Working Drawings of Colonial Furniture*. If you missed the preceding articles on a mirror and a tavern table, you can obtain working drawings of the two pieces by sending for our Blueprint No. 105 (see page 109).

You'll Like To Make Things Out of Wood With This



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Trellises and Fences

(Continued from page 78)

place while the joints and angles are being laid out. When cutting the joints it is best to saw on the inside of the lines so that a very tight fit may be obtained. If too tight, the extra stock may be gradually trimmed away.

The two brackets can be laid out full size with the aid of the 1-in. squares as shown at 4. Note that two shapes are suggested, one 6 by 7 in. overall and the other 6 by 9 in. either may be used. Two can be cut from a piece 6 by 14 in. by laying them out in the most economical way, that is, one within the other like two reversed and interlocking C's. The pieces are sawn with the aid of a compass saw, turning saw, or fret saw, or the drawing can be taken to a cabinet shop where for a small amount the cutting will be done on a band saw.

Wooden barrel hoops are sometimes used effectively to make curved parts of trellises.

In the trellis shown in Fig. 2 it will be seen that a variation of the half lap joint has been indicated. If this type of construction is used, a very strong joint will be the result. The curved braces or brackets are the same size and shape as those used in the first trellis. The material necessary is 24 ft. of ¾ by 3½ in. stock and one

FIG. 6

Four methods of making light, decorative fences to serve as vine supports and screens.

piece ¾ by 6 by 14 in. Other designs are suggested in Figs. 4 and 6, indeed, the possibilities are endless.

For Fig. 3 it is necessary to have 17 ft. of ¾ by 1½ in. stock and a piece ¾ by 4 by 8 in. for the semicircular top, if used.

For Fig. 4 the materials are 35 ft. of ¾ by 1¼ (or 1½) in. stock and one piece ¾ by 12 in. by 3 ft. 6 in. for cutting curves and rings.

What has been said of the construction of trellises and supports is also true of making simple fences. Figure 5 is a relatively light and inexpensive design. Some very interesting patterns may be worked out in the building of these fences, as is shown in Fig. 6.

It will be understood, of course, that the dimensions given are merely suggestions on the author's part; the designs can be worked out in various sizes and many different ways. The amateur's tendency perhaps is to err on the light side. Fences are exposed to considerable stress and strain, especially in the northern states where winters are severe and there is much ice and snow. It is astonishing how even 1 by 4 in. stock will sag under the pressure of high snow drifts and ice crusts.

When a fence is low and quite long and the cost must be kept at a minimum, it is sometimes possible to work out a satisfactory design by using ordinary plasterer's lath instead of lattice strips, although the fact that laths are not smoothed renders them rather difficult to be finished with paint.

The setting or putting into place of a trellis, fence, or other garden fixture is quite important. If it is placed carelessly in the ground and the earth is not tamped firmly, it will soon sag and lean.

A good method of setting up the ordinary trellis is to place a post exactly under where the trellis is to stand. Sink it at least 18 in. deep. This post should be tamped in place and sawed off so that about 6 in. of it extends above the surface. To this protruding end may be attached the trel-

(Continued on page 146)

Trellises and Fences

(Continued from page 127)

lis with either nails or screws. If desired, the post may be set in concrete, and a more stable and rigid construction thus obtained.

In the case of fences, small split 2 by 4 in. or 4 by 4 in. posts may be used. These should be sunk in the ground an ample distance to insure solidity, and preferably well below the frost line.

Some method of finishing garden furnishings is necessary because the surface of the wood must be protected from the sun and the rain or decay soon begins. Either stain or paint may be used, but paint has the greater protective value. White, cream, brown, or green are the colors ordinarily used, all of which look well in a garden setting.

If paint is used, apply not less than three coats, the first of which should be well thinned with linseed oil. If stain is used, one coat of a high grade oil stain for outdoor use will serve the purpose very well.

Truck for Outboard Motor

THIS light truck illustrated below, which saves the labor of carrying an outboard motor from house to dock, was made at a

Carrying an outboard motor to the dock on a truck mounted on two old bicycle wheels.

trifling cost from two old bicycle wheels and odd pieces of wood for the frame.

The frame is 14 in. wide and 3 ft. 6 in. long. The axle, which is an iron rod, is stapled to a crosspiece 1 in. from the bottom of the frame. There is another crosspiece of 2 by 2 in. wood bolted to the frame 22 in. from the bottom for clamping the motor.—W. A. Gordon.

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Planing stop fixed at end of work bench.

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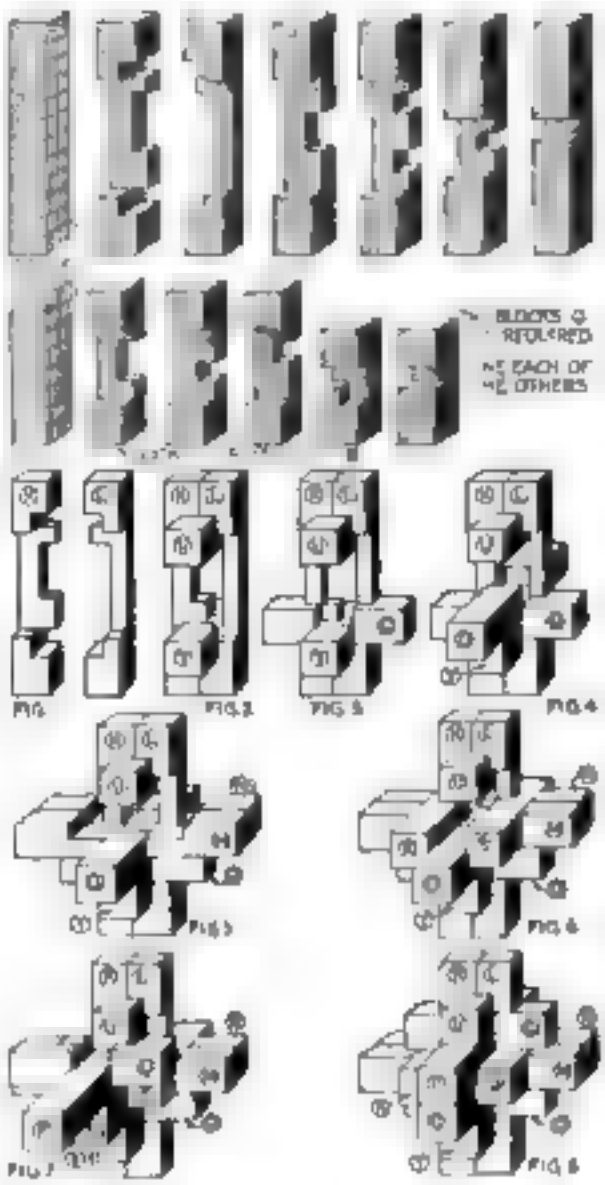
Magic-Cross Block Puzzles

(Continued from page 110)



Puzzle II.—How the blocks are cut and put together to form a peculiar compound cross.

The *G* block is pushed through the slot and fitted. *I*. Block *H* is placed before *K*, *L*, its ½-in. cut engaging *G*. Block *V* is placed behind *K*, *L*, its ½-in. cuts engaging them. 5. Blocks *R* and *N* are placed one on each side of *G*, their ½-in. cuts engaging *K* and *L* respectively. 6. A ½-in. square hole is left into which the combination *P* and *Q* is slid. 7. As the cut on *P* is not central, it must be turned so that its longer arm is pushed into the hole.

The illustration of the assembled puzzle 8 shows that while it is of the same size and shape, there are differences in the position of the pieces.

It is customary in making these puzzles, as well as the Chinese cross, to trim the edges of the ends neatly after the puzzle is assembled. If woods of different colors are used and combined artistically these puzzles can be made quite ornamental. Six blocks may be of one color and six of another.

To explain the mystery involved in the longer blocks of the second puzzle, it may be pointed out that if values are assigned the different cuts, as was suggested once in an article on solving block puzzles (May, 1927 issue) on the basis of ½-in. cubes, the first puzzle will have 88 such units, the second 120, or a difference of 32. This is exactly the volume of the extra length in the four 2-in. blocks. Hence, the seemingly surplus wood was simply cut away from the interior of the blocks.

If you would like to make other block puzzles, send for POPULAR SCIENCE MONTHLY Blueprint No. 65. It contains a large variety of block puzzles, including the Chinese cross. With one exception, all the puzzles on the blueprint were designed by the Rev. Mr. Smith, who was once editor of the "Enigma" and is a distinguished expert on puzzles.

Doomed to Die—and They Live!

(Continued from page 19)

organizations, welfare societies, and other agencies appealed to the U. S. Health Service, which recently began a nation-wide survey of the luminous paint industry. According to Ethelbert Stewart, commissioner of labor statistics of the U. S. Department of Labor who some years ago was instrumental in outlawing white phosphorous from American industry, there is no question that poisoning by radioactive substances is an occupational disease. He has promised that, if the findings of the Health Service warrant it, drastic action will be taken by his department to prevent further loss of health and life from this insidious source.

Just recently, the Council on Physical Therapy of the American Medical Association issued a set of safety rules for the handling of radium, showing that the medical profession, which has great faith in the substance as a curative agent in the treatment of certain diseases, particularly cancer, also views it in the light of a deadly danger.

RADIUM, the Council advises, should be kept in holes drilled in thick lead blocks and these should be stored in safes away from places where people work or live. Physicians handling the tubes containing radium should do so with long-handled wooden tongs, and when applying it to patients the doctors' hands should be protected by a plate of lead at least an inch thick!

Lately, "radium emanation," a gas produced by radium, has been used medically instead of the element itself and the Council also cautions against the dangers of the gas, which is highly radioactive and may form active deposits when taken into the lungs. Physicians using the emanation are advised to protect their hands with rubber gloves, as the rays emitted by the gas may cause radium burns and even growths resembling cancer.

Meanwhile, what of the five young women? Are they bowed down under the sword of Damocles suspended over them by a thin thread of scientific uncertitude? Have they been embittered by years of physical agony and mental anguish? And what are their reactions to the misfortunes their fantastic fate dropped into their laps?

To find the answers to these questions I went to New Jersey the other day for a chat with each of the women. To my pleasant surprise I found them cheerful, uncomplaining, sweet tempered, unafraid, as happy as the average normal person. Yes, they really were happier. For to each of them the compensation and pension has brought something which few of us, no matter how well or wealthy, ever receive—the fulfillment of a life-long wish!

ALL of them had left the employ of the radium corporation and three were married before the first symptoms of their malady appeared. Only one of the married women, Mrs. McDonald, has children, a boy and a girl.

The young mother's first thought when she received the $10,000 check was for her youngsters. At once the major part of the money was invested in the form of a trust fund for their education. Then Mrs. McDonald felt that, no matter what might happen to her, their future was reasonably secure. And as she has difficulty in walking, even with the aid of a cane, a small car was bought in which her husband takes her on short trips. Aside from rides in the country, her favorite pastimes are card games, checkers, dominoes, and a little light reading now and then. Looking into the delicate featured, rosy-cheeked face of this young woman with black, bobbed hair, I discovered few signs of suffering and none of despair. She is a happy mother. Her children are safe!

Strange as it may seem, Mrs. Larice, Mrs. McDonald's sister, is the picture of contentment. Her cheerful face was wreathed in smiles as she told me that the $10,000 had been the means of making the dream of a life time come true—a comfortable car and a trip to Niagara Falls and Canada! She and her husband, who is a bricklayer, took the journey last summer. Since then her pleasures have been her radio, her goldfish, the movies, and short jaunts in the country, often with Mrs. McDonald.

THE third married member of the quintet is Mrs. Hussman. Though severely crippled, she, too, fairly radiates happiness. The reasons are not far to seek. One look at this well-dressed young woman with her charming smile and gold hued bobbed hair convinces even the casual observer that here is a person blessed from birth with a sunny disposition. But there are other causes. Mrs. Hussman loves music and the compensation money enabled her to buy a player piano and a fine cabinet radio. Now, day and night, she has all the music she wants. Moreover, her young husband is devoted to her.

Soon after the settlement a big, comfortable sedan was bought and Mr. Hussman took his wife on a long, leisurely tour. Beside her greatest hobby—music—Mrs. Hussman has her flowers of which she is unusually fond.

All her life, Miss Schaub, the youngest of the five, had cherished two desires—to take up the mortgage on her father's home in Newark and to pursue a literary career. Fate, while dealing her a dreadful blow, gave her the unexpected chance to attain both. Living quietly in a convalescent home in a hilltop about twelve miles out of Newark, Miss Schaub spends her days reading the best in current literature and writing poetry on the portable typewriter which was the first purchase she made when she received her check last June. She, too, has become the owner of an automobile. Last summer she enjoyed a long vacation in the Catskill Mountains in New York. Some day she told me, she hopes to take a trip to eastern Canada and visit the famous shrine of Ste. Anne de Beaupre in the province of Quebec.

BUT while these four women are as cheerful and contented as any strong and healthy person you may meet, the happiest of the five by far is Miss Fryer. She is the only one who is fighting fate! From the first, she refused to let her misfortune change her mode of living or her philosophy of life. Day after day, this plucky girl efficiently discharges the duties of the position with a Newark trust company she has held for several years. And twenty-five operations performed on her jaw have failed to break her of the habit of smiling.

That smile of hers is one of courage and of hope! For of all the five women, Miss Fryer is the one with a strong, abiding faith in a happy ending for the gruesome drama of their lives. Realizing this, she takes an absorbing interest in the cases of the other four girls, visiting them, bolstering up their flagging hopes, and acting as a "liaison officer" between them and the physicians and specialists.

And the money?

"Not a cent of it has ever entered this house," she told me.

Naturally I was surprised.

"To me," she explained, "money doesn't mean luxury. It means security. Those [illegible] are safely invested."

"What for?" I caught myself asking.

Miss Fryer smiled her brave smile as she answered.

"For the future!"

Unusual Men in the Public Eye

(Continued from page 136)

with unusual inventive genius. When he was a barefoot boy of seven in the mining country around New Galilee, Pennsylvania, sent home for good from the little red schoolhouse because of his inability to learn his A B C's, young Ethan developed his first invention. He heard his mother sighing and saw her rubbing her aching arms after stirring apple butter with a big wooden ladle in a copper kettle. So he hitched a miscellaneous assortment of belts and pulleys to her rocking-chair, and Mother Dodds from then on made the smoothest apple butter without rising from her favorite seat or looking up from her knitting.

At seventeen he left home and his father's small coal mine and went to work as a blacksmith's helper in the Westinghouse works at Pittsburgh. It wasn't long before Dodds was George Westinghouse's right-hand man, and when Marconi came to Westinghouse with his first models for wireless, the erstwhile blacksmith's apprentice was assigned to help him.

Later, he became associated with E. H. Harriman, the railroad magnate, who built a laboratory for him beside his own home at Central Valley, New York—where Dodds still lives—in order that he might be at the financier's call any time, day or night.

When you make a night trip and enjoy some rest in your Pullman berth, you have Ethan Dodds to thank for it. He invented the all-steel sleeping car. The experts of the day had no faith in Dodds's ideas, but the late Robert Lincoln, son of Abraham Lincoln and president of the Pullman Company, had plenty of it, and the cars were built. When you switch on the light in your berth, you are using a Dodds invention. In the morning, when you wash at the lamp in the Pullman wash room, think of Dodds. He invented it and also the small separate device for wetting and rinsing your toothbrush. One of these days, Dodds says, your berth will be supplied with fresh, clean-nerized air. He is now working on a contrivance to make that possible.

Among Dodds's latest inventions are an emergency miner's lamp, which stores "cold light" for two and a half hours; the steel ends on freight cars that prevent breaking of the cars through shifting of loads; and the portable electrical circular handsaw, which is now generally used by carpenters and cabinet and pattern makers. The "cold light" was used aboard American submarines during the war.

Dodds is just fifty years old, is married, and is the father of four children. The fact that, next to Edison, he is the world's most prolific inventor does not impress him in the least.

"What difference does that make?" he asks. "I cannot help inventing things any more than a duck can help swimming."

Savior of the Birds

A CANADIAN magazine recently conducted a poll to find out who was considered the greatest living Canadian. The fifth largest number of votes was cast for Jack Miner, the four other men being political leaders.

Jack Miner is a small drastic manufacturer of Kingsville, Ontario. His name is known in Paris, London, Leningrad, Melbourne, and Capetown as one of the world's greatest lovers of birds and students of bird lore. Twenty-five years ago, he originated the sanctuary idea for protecting, feeding, and conserving the wild fowl of the continent. Today there are bird sanctuaries in every civilized country, and the United States Congress not long ago passed laws establishing 145 of them for the preservation of American migratory birds.

Miner's sanctuary is one of the show places in eastern Canada. In the season when the wild geese nest and

(Continued on page 138)

Unusual Men in the Public Eye

(Continued from page 137)

winter there, the 2,000 of Kingsville's population often are increased to 15,000 by sight seers who come to view the swarms of migratory fowl.

Miner is the only man who has caught and tagged wild Canada geese to study their routes of migration. Using a unique trap of his own invention, he has caught as many as 300 geese at one time. The birds are kept in captivity just long enough to place aluminum bands on their legs, then they are released. The wealth of knowledge concerning the migratory routes and other habits of wild fowl thus gathered is kept on record by the Dominion government.

He also has invented the now famous Jack Miner crow trap, with which, at times, he has caught more than 300 birds at once. This device Miner constructed to check the alarming increase of crows in Canada, where the song, insectivorous, and other valuable birds were threatened with extinction by the "nest robbers," as Miner calls them. The plans of this trap Miner presented to the U. S. Biological Survey, which has had blueprints made of the invention to be distributed among American bird lovers who wish to aid in decreasing the crow menace.

The annual cost of feeding the birds that congregate on Miner's sanctuary runs between $3,000 and $6,000. The Dominion government contributes a yearly grant of $500 toward this fund and the provincial government of Ontario $400. The balance is made up by Miner himself who devotes all of his lecture fees and the royalties of his widely read book, *Jack Miner and the Birds*, to the purpose, and by contributions of friends interested in his work.

As for his lectures, no bird lover has spoken to larger numbers of people. Last winter, it is estimated, he spoke within six weeks to more than 300,000 school children during mornings and afternoons, giving lectures for adults at night, his audiences often conjuring as many as 4,000 listeners. Two years ago, Canadian conservationists paid him signal tribute by organizing the Jack Miner League of Canada, which corresponds to the Izaak Walton League in this country.

Miner is a native of the United States, having been born sixty-two years ago in Dover Centre, Ohio. As a boy of thirteen, he moved with his family to Essex County, Ontario, where his father had a small tile manufacturing plant. When he grew to manhood, Miner himself started what he calls a "one-horse tile yard," which he and his sons still operate. As the clay for the tiles is excavated, the cavities are made into artificial ponds that serve as havens for the migrant water fowl.

Makes Watches Keep Time

A MODEST little man who rarely leaves his small combination laboratory and library in the heart of Paris is responsible for the fact that untold thousands of watches will go neither too fast nor too slow in the future.

He is Dr. Paul Ditisheim, considered the world's foremost horologist. Not long ago, he devised an air-tight watch case of elinvar, an alloy of nickel, steel and chromium, which makes watches virtually immune to magnetic influence—the chief cause of their inclination toward excessive speed or slowness—especially the latter.

Observations over a number of years showed Dr. Ditisheim that eighty-five percent of the watches carried by Parisians—and, for that matter, by persons in any metropolitan center were affected by magnetism, to which the steel portions of their works were exposed by a ride in the subway, a stroll past a power house, the use of electrical devices, and in scores of other ways. He conceived the idea of constructing a case of

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Unusual Men in the Public Eye

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a metal that would resist this effect, which he found resulted in deviations ranging from ten seconds to as much as three hours out of every twenty-four. But the question was—which metal to use?

In 1900, experiments made in England had proved that a chronometer inclosed in iron would withstand magnetic influence, but it was obviously impracticable to clothe a watch in iron. One day, while making the first elinvar hair spring, Dr. Ditisheim discovered that the material was only slightly magnetic and, moreover, possessed the desirable quality of losing its magnetism the moment it was removed from the magnetic field. After that, the actual construction of an elinvar watch case was a simple matter.

The casing is only slightly thicker than tin foil and is made virtually air-tight, thus protecting the works against grit and other harmful particles. The case consists of a ring encircling the works, a concave plate upon which they rest, and a flat plaque which covers them. This plaque can be made so that it will support the dial or take its place. In the latter case the hours are lettered directly upon it.

Dr. Ditisheim was born in Switzerland, the home of fine watchmaking, of a long line of horologists. He started his career as a practical watchmaker, but soon forsook the workbench for the laboratory and devoted himself to research and experiments. Through his work with temperature compensation, magnetism, and watch oils he has won international renown. Today his opinions are regarded as the last word in horology, whether they are offered in solution of problems connected with the micrometric shock-button watch, or the enormous underground pendulums that regulate the Paris Eiffel Tower clocks.

Diamond Fields Once Home of Stone Age Men

A POWERFUL, large-brained race lived in South Africa many thousands of years ago, Dr. Robert Broom, a fellow of the Royal Society, in England believes, basing his conclusion upon the finding of ancient remains on the springbok Flats on the Transvaal not long ago. Buried in limestone, beside the bones of an extinct type of buffalo, was the skeleton of a man, evidently trampled to death by the wounded animal. The skull closely resembles that of the Cro-Magnon man. However, it had a relatively low roof, which Dr. Broom suggests links it to the Neanderthal man and the bushmen of the present time.

The presence of many stone implements in the diamond fields of the Transvaal has led to the belief that the territory was once inhabited by a prehistoric race, but, until the discovery of this victim of a tragedy of the Stone Age, no direct proof was available. The name "Bushveld Man" has been given to the skeleton, to distinguish it from the skeletons of other early men.

The "Bushveld Man," living in the middle Stone Age, perhaps more than 20,000 years ago, probably belonged to a race that dwelt along the banks of the River Vaal, and numbered hundreds of thousands, the anthropologist concludes. He advances the theory that these ancient people were the ancestors of the Korana tribe which lives near the same region today.

Going Back to the Farm

ALTHOUGH 1,978,000 people migrated from farms to cities in the United States last year, a recent report shows that outflowers to the number of 1,374,000 made changements for country life during the same twelve months, indicating a trend back to the farm.

Why Is Perpetual Motion Impossible?

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is the radium clock devised by Lord Rayleigh, of England. It is designed to run, without being touched by human hands, for a thousand years. A speck of radium was placed in a small glass tube in a vacuum bulb. Rays carrying negative electrical charges are given off by the radium, which remains positively charged. The gradual accumulations of negative electricity cause two gold leaves to move toward the positively charged radium in the glass tube. When they touch the tube, their charge disappears and they return to their former position. Every three minutes the leaves move, thus keeping perfect time; this is expected to continue as long as the radium lasts.

Such devices, of course, are not true perpetual motion machines, for they are not creating the energy they need, but are merely using energy already in the world. In this same category are "self-winding clocks" which are kept going by barometric or temperature changes, and also the schemes to harness the tides or, as planned by the noted French physicist, Georges Claude, to produce power by using the difference in temperature of ocean water at the surface and at great depths.

Along with those who have been deluded into thinking they have discovered perpetual motion are those who deliberately set out to hoax the public, often selling stock in their fake devices. Famous among such hoaxes was the mechanism exhibited in Philadelphia by Charles Redheffer a little more than a century ago. It created such excitement that the legislature of Pennsylvania appointed a commission of eminent engineers to examine it.

At the appointed time, the commission arrived at the house where the wonder was kept. They found the house locked. Examining the machine through a barred window they saw a vertical shaft carrying a horizontal disk on which two inclined planes bore weighted cars that descended and rose at certain points in the rotation of the disk. The horizontal disk was a spur wheel and the teeth in its edge engaged with those of a smaller wheel which, ostensibly, drove the rest of the machinery.

A small boy, who had tagged along with the learned men, spied something that the commissioners missed.

Look!" he shouted. "The wear is on *the wrong side of the cogs!*"

Sure enough, the wear on the cogwheels showed that the device was running backwards. The small wheel was driving the larger. Although the source of propulsion was not discovered, the deception was unmistakable.

Redheffer disappeared, but the following year he blossomed forth in New York where he attracted great crowds with a duplicate of his device. This time the keen ears of Robert Fulton, inventor of the steamboat, tripped him. Fulton stood in the crowd before the machine for a moment and then exclaimed: "Why, this is being turned by a crank!"

To his practiced ears the uneven motion of the revolving wheel proclaimed that the machine was actuated by a crank. The crowd searched the house and in a second-story loft discovered a tired old man holding a piece of bread in one hand and patiently turning a crank with the other. Catgut strings running through the walls connected the crank and the machine.

Since 1811, the U. S. Patent Office has told those who submitted plans for perpetual motion machines that the building of such devices should not be attempted "until the sun rises in the west." It refuses to consider any application for such a patent unless it is accompanied by a working model. Needless to say no patents have been granted.

How to Break In Your New Car

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"Theoretically it should," Gus explained, "but actually it doesn't. If you don't believe it, connect an electric doorbell in series with a battery, touch one of the wires to the crank case, and let the other rub against the exposed end of the crank shaft while the motor is running. You'll find the bell will ring almost as steadily as if the wires were hitched to each other. The crank shaft is spinning in bearings supposed to be flooded with oil, yet the bell rings—proving there's a real metal-to-metal contact at some point.

"What do you suppose happens when the tiny metal ridges on the shaft bump into the microscopic rough spots on the bearing surfaces?" Gus asked.

"They commit assault and battery, I suppose," suggested Webb.

"That's exactly what they do, if—" and Gus paused significantly—"they come together at high speed. If the little ridges and points rub together at slow speed in the presence of plenty of oil, they just wear each other till there aren't any ridges left. But when they slam together at high speed they tear loose and leave the surface rougher than before. It takes the life right out of the bearings. The damage may not show right away, but the car will grow old before its time.

"How slow ought I to drive?" Webb asked.

"I'd stay under twenty miles an hour for the first fifty miles or so," Gus advised. "Then don't go over twenty-five until you've reached the 500-mile mark, and not over thirty 'til you've passed 1,000 miles. And on quick get aways. Be gentle. Let the clutch in easy, don't jam on the brakes, and don't do any racing up the hills in second speed.

"I'll see where I get a chance to enjoy the scenery for a while," Webb laughed. "What's the rest of the bill of particulars?"

"Drain the crank case and put in new oil at the end of 250 miles," he added. "Even if the car has an oil filter it's worth while, because until the piston rings get worked in, raw gasoline gets past them into the crank case. Have the rear wheels tightened at the end of 500 miles. Then get 'em properly seated and you won't have any more trouble. Let 'em stay loose and you're liable to bust an axle when you least expect it.

"One thing we ought to do right now is add about a pint of oil to the gasoline in the tank. It'll give a little extra lubrication to the cylinder walls and piston rings while they're wearing in. After you've covered a thousand miles, you want to go over the car and check the tightness of every bolt and nut. Also readjust the clearance of the valve tappets. The brakes ought to be tested to make sure they're holding evenly after the brake lining has had a chance to wear in.

"That's about all, outside of the usual precautions about keeping the car greased and oiled," Gus concluded. "After that first thousand miles, though, when you first start burning up the road, it pays not to keep the car traveling at high speed for long stretches at a time. About every mile or so take your foot off the throttle for a few seconds—just long enough to let the car slow down to normal speed. That'll give the oil film on the cylinder walls a chance to renew itself.

"If you stayed in this shop awhile you'd soon see how many sets of piston rings I have to replace, how many scored cylinder walls have to be honed or reground, how many connecting rods get loose or burn out—just because dumbbell owners step on it while their cars are brand-new."

Here Are Correct Answers to Questions on Page 52

1. The bullet leaves the barrel before the latter has time to move upward more than a small fraction of an inch, and this effect is taken care of in the design of the sights so that you do not have to allow for the jump at all. Simply line the sights on the target.

2. Black powder does not burn progressively as does smokeless powder, nor does it burn as completely. There is, therefore, a heavier muzzle blast with black powder and there being a greater bulk of solid matter in the black powder that is expelled from the muzzle in the form of finely divided particles, the reaction against the breech of the gun is greater than it would be if the bullet were heavier.

3. Now that all the old-time Western bad men and other crack shots are dead, fiction writers may credit them with miraculous feats with the "six-gun" without fear of contradiction. This leads to all sorts of exaggerations, many of them obviously impossible because beyond the mechanical capabilities of the weapons.

4. Action and reaction are equal and opposite. However, the kinetic energy stored in any object is determined by the force acting on it multiplied by the space through which the force acts on the object. In the case of a rifle, the pressure inside the barrel acts on the bullet while the bullet is traveling the length of the barrel, but it acts on the breech only while the weapon is recoiling less than a quarter of an inch during the bullet's travel from cartridge to muzzle.

5. The maximum pressure developed in the regulation Army rifle is approximately 50,000 pounds per square inch.

6. The ultimate range of a high power hunting rifle may be as much as three or four miles under certain conditions, and so many accidents have occurred in relatively thickly settled hunting districts that long-range weapons have been barred. Shotguns, when used with buckshot, or even with BB shot, are powerful killers at short range, but the pellets cannot travel much great distances.

7. In all automatic pistols it is necessary to press the trigger once for each shot fired. Should a pistol such as the .45 Army automatic be constructed without the disconnector which prevents continuous discharge, the unfortunate who fired the weapon probably would shoot himself before the magazine was emptied, because each succeeding recoil would swing the gun backward through a considerable arc.

8. Assuming that the duck is flying directly across the line of sight at a distance of forty yards and he is going at the highest speed, which may be nearly seventy-five miles an hour, you will have to hold approximately sixteen feet ahead to have the shot charge connect.

9. The so-called "dime test" of the choke in the bore of a shotgun is an exploded theory. It is the form and shape of the choke rather than the actual amount of constriction that governs the close shooting properties of the barrel.

10. All bullets, no matter how high their velocity, start to drop away from the axis of the bore inward the earth at exactly the same speed, as though they were simply pushed out of the muzzle by hand. The reason a rifle appears to shoot flat is because the line of sight is above the bore and consequently the axis of the bore is pointed slightly upward and the speed of the bullet allows it to cover a considerable distance in a short time.

Has Fame Made Lindy "High Hat"?

(Continued from page 3)

save his life. He talked readily about the action, when I once mentioned this, but not a hint of his emotions. Later when I had flown with him in several planes, I understood. Lindbergh can divorce his mind from all but his flying. In a difficult moment he is thinking of nothing but the proper action; his thoughts are not occupied with alarm and doubt. Hardly one man in a million can cold-bloodedly submerge his feelings even in the face of almost certain death, leaving his mind free for sure, swift decisions. Lindbergh can and does. That is why he is a super-pilot.

Not that he is not human. I found him congenial, warm, and the possessor of a most unusual sense of humor. After nearly five days of daily association with him, during banquets, parades, interviews, and in the privacy of our hotel, I found I admired him more than ever. For instead of being the "blushing, modest hero" who would have been a difficult companion for those with him, he was a "good scout." And nothing would have roused him to anger more than a hint of "hero" by one of our party.

TODAY who has watched the people of forty-eight states lose themselves in mad cheers and violent admiration for Lindbergh it seems incredible that these same people should ever believe he has changed. Yet he has been accused of losing his modesty of bewailing his diplomacy and replacing it with downright rudeness, and of complete lack of consideration for his admirers. A few have even said he is not as good a pilot as he was, pointing to the accident in Mexico when a wheel dropped from his plane.

Lindbergh himself saw this situation coming, even while the national tour was in progress. Milburn Kusterer, our advance man, was talking with the Colonel and me. He had just returned from a battle with politicians who wished to exploit Lindbergh at every turn. Kusterer had won, but he was not happy.

"Slim, these people have power," he told Lindbergh. "They're used to getting what they want, they'll be ready to get even with you for not granting all their personal favors. And when you have to tell some reporter twice not to ask your private business he's going to be waiting for some chance to slam you. Right now, they don't dare. The people wouldn't stand for it. But it's coming."

"I know it," said Lindbergh thoughtfully. "But I can't give in to those requests. I'm trying to help aviation, and those personal things don't help a bit."

After the national tour, Lindbergh expected a let-down in the pressure that had been continuously exerted on him. But it was just the opposite. He soon made a decision to "retire" to private life, before he was lost in the pulling and hauling of those who were always trying to "use" him for their own ends.

THIS started criticism in itself. Several writers flatly denied his right to a private life, and predicted he would find it impossible to carry out the idea, separating any public work he did from all his private affairs. But he has clung to that decision, though at a cost.

He has had to be constantly on the move, to keep ahead of the "seekers." He is hunted the moment he reaches a city. A score of people who know him will be searching for him, in addition to the hundreds clamoring to see him. It has been like this since he returned from Paris—only behind locked doors has he had any privacy. Yet out of the clamoring thousands, it is doubtful if Lindbergh can count more than a dozen friends who will not follow up their greeting with some request for a favor. It is odd that he has not lost all faith in human nature.

One effect has been to make him a little more blunt in turning down the "seekers," which naturally has been the opening wedge for the charge of high-handedness. But a single instance should show how harassed he has been. One afternoon an official of a certain state buttonholed Lindbergh as he was leaving an airport.

"I'm going to take you out to my place tonight," he informed the Colonel importantly. "Just a few friends. I'll be in to get you later."

Lindbergh had never met the official before, but he smiled pleasantly, though his every moment was taken.

"I appreciate that very much," he said politely, "and if it were possible I'd be glad to come. But my plans cover every minute of the time I'll be here."

THE official was not at all abashed. He laughed heartily.

"Colonel, I guess you don't know me," he said, greatly amused. "Everything I fix up always goes through. I'll get you back in time. You might as well say yes." He laughed again. "You see, I'm one of these fellows that won't take no for an answer."

Lindbergh's smile had flickered and died. His eyes were like clear ice, and when he spoke his voice was as cool as his glance. Yet there was no anger in it.

"I am sorry, but I shall have to say no," he replied, slowly and distinctly. Then he held out his hand. "Thank you very much," he added, and turned away.

The man who never took no for an answer looked after him dazedly. This was not the bashful embarrassed Lindbergh he had read about. Someone had made a mistake.

This is only a mild instance of the things that went to make up Lindbergh's daily life, until he surrounded himself with an armor of reserve and aloofness. I have seen him several times since our daily association ended, and each time I have noticed that this armor is heavier. Yet on each of these occasions I have also been able to see him alone, or at least removed from public places. And I know that he is still the Lindbergh who flew to Paris without any blare of trumpets—and the same "Slim" who once woke me up when I slept overtime by dropping hot candle tallow on my ear.

TO THOSE who do not know Lindbergh it may seem odd that he should have a keen sense of humor. It is a fine balance wheel for his nature—and it might well be called his "safety valve." Were it not for that humor Lindbergh might not have lasted through the past two strenuous years. But it has been possible for him to make up for the most trying days by calling on that plentiful quality, usually to the dismay of his nearest friends.

I was afraid that under the barrage of requests, criticisms, and other trials he might become somewhat hard, perhaps lose that almost boyish manner which makes him so human an acquaintance. But I found on my last visit with him that there was no need to worry.

Several others were there—Major Lanphier, Mahoney, who built the *Spirit of St. Louis*, and Knight, Bixby, and Robertson, backers of the Paris flight. When I came in they were engaged in what seemed a test of marksmanship. Lindbergh stood in one corner, his head thrown back, and a silver quarter placed on his forehead. His coat was off, and stuck in his belt was a newspaper rolled up like a funnel.

Closing his eyes, Lindbergh moved his head forward with a slight jerk. The quarter dropped into the funnel.

"You win," said Mahoney, and he became the marksman. Others kept up humorous comments on his ability, or lack of it. When I made some remark

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Lindbergh turned around and spoke to me. "It looks easy, but I'll bet you can't do it once out of three times.

I stood up, put the paper funnel in my belt, and placed the quarter on my forehead.

"Farther back," directed Lindbergh. "And close your eyes. That's what makes it hard.

My three months contact with him must have been in vain. I trustingly closed my eyes. Instantly a stream of icy water shot into the funnel from a pitcher. And it did not stop there.

I cannot prove it, but I know whose hand held the pitcher. While my clothes were drying, Major Lanphier looked over and grinned.

"Don't feel bad about it. Slim bit on it himself the other day. He almost had to go to a luncheon in evening dress.

THE statement that Lindbergh is not as capable a pilot as former years is ridiculous. He has added up hundreds of hours on all types of planes since 1927. He flies everywhere, in all kinds of weather. And the "crash" landing at Mexico City, far from being proof of poor flying, was an example of utmost skill. The average pilot, on learning that he had lost a wheel would come in as slowly as possible, tilting up the wing under which the wheel was gone. This would be correct at sea level, but Lindbergh was flying onto a field thousands of feet above the sea. The air was thin, and a stall landing might have caused a swift drop, with disaster.

Indeed, Lindbergh kept his flying speed until he was almost on the ground, then kicked the plane around. He struck up with least damage. That he was able to keep his head so well when his future was at stake and in danger is another proof of his extraordinary ability to concentrate on any task.

Lindbergh's lack of comment at any time in regard to his future has been the subject of much discussion. It is with no desire to be haughty that he has absolutely refused to discuss any phase of his engagement. He is merely carrying out the idea that Lindbergh, private citizen, is one person whose intimate affairs are strictly barred from the spotlight—and that Lindbergh, promoter of interest in aviation, is another, who appreciates the interest of the public and the great throng of those who continue to admire him, despite certain attacks.

There is just one thing I am quite sure Lindbergh will lose by his marriage. That is $1,000 in cold cash. Back in the days before the flight to Paris, he and his old flying pal, Phil Love, each made a wager to that amount that the other would marry first. At this writing, unless Phil falls hard and fast, Lindbergh pays.

WHEN I hear of Lindbergh's "lack of consideration" I never fail to remember an incident that happened in 1927. He had promised to fly over a children's hospital on a certain day; the unfortunate little inmates were to be wheeled out on the lawn to watch for the *Spirit of St. Louis*. Someone gave Lindbergh an erroneous direction, and he missed the building. The little cripples were heartbroken. Lindbergh heard of it late that night. There was no exhibition of maudlin sympathy—but he sent a message to the superintendent, and next morning he doubled back 100 miles to circle low and wave a greeting. He insisted that this be "soft-pedaled."

Lindbergh after two years—to me—is the same man. It is a tribute to his greatness, to his strength and simplicity, that he has been able to go through those two years unspoiled and before disgruntled people have summoned up enough nerve to launch their attacks.

Others will be disappointed—and other stories will appear. (Continued on page ...

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The wave has started and it will roll on. Perhaps realization by the majority will stem the tide—perhaps a misunderstanding few in power will eventually bring Lindbergh's name down from its lofty place.

And then—if that time comes—his real greatness will come to light. For if he were petty at heart, if the applause were secretly necessary to his existence—if, after all, he were pretending—the changing tide of public opinion would break him quickly.

But even if the entire press of the United States, molding public opinion, were to swing against him as solidly as it was for him in 1927, the Lone Eagle would still be the same "Slim" Lindbergh, going about his affairs as he thought right—and asking no favors!

Speed and Your Car

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Lee Bible, Florida mechanic, it crushed this year, killing Bible and a photographer standing near by. It was the second death at Daytona in the quest for the mile record. A year ago Frank Lockhart, American racer, had met death when his *Black Hawk Special* blew a tire at about 200 miles an hour, somersaulted, and crushed him.

One of the witnesses of Major Segrave's 231-mile record this year in a car patterned after a seaplane was Tommy Milton, now retired from racing and an official of the American Automobile Association. Segrave's car, be interest, was a far cry from his own diminutive speedster. It was almost an airplane on wheels, even to its finlike rudder, and suggested that aerodynamics may play an important part in auto design of the future.

Captain Campbell almost equaled Major Segrave's record the other day by piloting his latest speed car across the dry bed of a Transvaal lake in South Africa. He has managed to set a new five-mile record, at the cost of a badly wrenched back from the bumpy course. The difficulty of finding a track for a modern mile record may be imagined by realizing that it takes three miles to get a car up to its top speed, and three miles more to stop it.

FROM one to nearly four miles a minute! No better example of the development of auto design could be imagined. But super-speed racing machines cost thousands to build. Few manufacturers could afford to make such tests, even if they could find men to drive the cars or speedways to drive them on. Hence the supreme importance of another type of speed test, of which the Indianapolis 500-mile race is an outstanding example.

In 1909 a group of auto pioneers who believed the future of the automobile lay in speed tests purchased a plot of ground in Indianapolis and built a two-and-a-half-mile track of tar and crushed stone to be used only by cars of limited engine size. The first race was a holocaust, the heavy cars dug huge trenches in the track, veered, and several killed their drivers. In December of the same year the course was repaved with brick, as it remains today.

On this famous course some of the most picturesque figures of the racing world have pitted their nerve against each other. A newcomer, a twenty-four year-old lad named Leo Meyer, created a sensation last year by walking away with the classic. He piloted his Miller special over the 500-mile course at an average speed of ninety-nine and a half miles an hour—less than two miles below Peter de Paolo's speed when he set the track record of a 101 mile-an-hour average in 1925.

How can racing influence auto design? In seventeen years the size (Continued on page 145)

Speed and Your Car

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of engines allowed in the Indianapolis Classic, under the rules, was cut from 900 to 91½ cubic inches yet, to the surprise of engineers, the cars become faster instead of slower. The 1911 race was won at a speed of seventy four miles an hour, those of recent years at better than ninety-five. Engine makers learned how to put more efficiency in small engines. The present racing motor, according to the National Automobile Chamber of Commerce's method of rating, is of only 15.3 horsepower less than that of most pleasure cars, yet on the track it develops 200 horsepower—enough to drive a racing car at more than 140 miles an hour at top speed. Needless to say, auto manufacturers were not slow to incorporate the small new motors, suitably modified, in their latest models and for business and pleasure.

Nevertheless, manufacturers have complained that the shrinking size of racing cars has changed the character of races from makers' contests to races for individuals with special-built one-man cars. One consequence has been the innovation of races for manufacturers' stock cars, in which remarkable records have been set by duplicates of the models you see in show windows.

Now the Contest Board of the American Automobile Association announces that in 1930 two-seat racers will reappear on the Indianapolis speedway for the first time in eight years. Motors may be many times larger—as large as 366 cubic inches. In the opinion of Capt. E. V. "Eddie" Rickenbacker, former racer and now chairman of the Contest Board, manufacturers will soon deliver two-man cars capable of bettering the marks of the smaller special racers.

WHAT will be the next gift of the race track to motoring? One possibility is the front-wheel drive. Cars of this type, tried out in races at Indianapolis, Los Angeles, and Atlantic City, have shown repeatedly that they can travel faster than any highway driver would ever require a car to speed. Already one manufacturer is preparing to introduce this novelty in America, and its debut in pleasure cars is likely to be a matter of a few months.

And the future? No one can say what startling innovations await. But there is reason to believe that if tomorrow's car exhibits radical improvements in speed, efficiency, or comfort, it will be thanks to the daredevils who laugh at death at a hundred miles or more an hour.

Improved Diesel Engine to Reduce Costs

REPORTS of a remarkable Diesel engine of an improved type were recently brought to the United States by H. C. Hallinan, a motor expert of a large manufacturing concern in Copenhagen, Denmark, makers of the new power plant. Operating expenses are said to be cut as much as 80 per cent by the invention, which is being tried out in locomotives on the Danish railways before being used in ships. Three vessels are to have the new engines, it is reported, two for service in the Far East.

The principle of the engine's operation is said to be a radical departure from the usual Diesel motor. In the old type, oil and air are sprayed into the cylinder and exploded under 1,000 pounds pressure. The new engine pumps only oil into the cylinder and keeps it under 6,000 pounds pressure, the air being drawn in later by the downward stroke of the piston, it is explained.

Compared with the old type of engine, the new model is from ten to fifteen per cent lighter and only one man is said to be necessary to tend it while it is in operation.

Learn to Fly with Larry Brent

(Continued from page 46)

who intended to obtain commercial licenses.

Most of the large companies have discontinued the practice of permitting students to work their way. They say that the students loafed on the job and made careless mistakes—didn't take the proper interest in their work.

The question of how the poor man is to become a commercial flyer is a difficult one. The cost of the first fifty solo hours, which a flyer must have to obtain an industrial or a limited commercial license, is about $1,000—unless he can rent a plane more cheaply than $20 an hour. I have heard of planes which can be rented for as low as $7.50 an hour, but I would hate to take one of them up! To this $1,000 estimate must be added flying expenses and cost of instruction to the solo stage. Between $1,500 and $2,000 would cover everything.

And how about jobs for those who have secured their industrial or limited commercial licenses? I have looked into this question pretty thoroughly and have found that not only are those first fifty hours hard to pay for, but the next 150, at the end of which a pilot goes up for his transport license, are not much easier. The flyer with only fifty or 100 or even 200 hours to his credit is not in great demand, he must scratch pretty lively to earn his living.

THE flyer in real demand is the veteran with from 1,000 to 2,000 hours behind him. Provided he has flown under all sorts of conditions, that man has learned *everything* there is to be learned about flying. And the transport companies are having a hard time finding him. They are bidding against each other, offering premiums and bonuses. They steal pilots from each other, with the result that little love is lost between transport companies. Factories are turning out ten-, twenty-, twenty-five-passenger and even larger planes on a production scale. They dare not entrust these big ships to unskilled pilots. Where will they obtain enough pilots who have flown 1,000—1,500—2,000 hours?

I brought up this question one rainy afternoon in the pilots' room at Curtiss Field. A number of pilots and students were sitting about, playing cards and listening to the rain beat on the roof.

Major J. D. Coth, an R.F.C. ace with a war bag of twenty-seven Germans, recently took a refresher course and is now instructing at Curtiss. Said the Major:

"Let the transport companies make a canvass of the old war flyers, both Army and Navy. Many of these men have never returned to flying. To obtain a transport license, they are compelled by the Department of Commerce to fly fifty hours within one year. Many of these men flew heavy bombers in the war and know the trick of handling a big ship. Let the transport companies offer these men a free refresher course and the free use of planes for those fifty hours."

ASSEN JORDANOFF, my first instructor, added: "Why shouldn't the transport companies take these youngsters who are coming along and let them use planes free until they have flown 250 or even 500 hours under all conditions?"

Bill Winston, the field manager—he's the man who taught Lindbergh to fly—put in:

"It may not be necessary to canvass the old-timers or help anybody along. All over this country, youngsters who took out licenses last year and the year before are flying their own ships, barnstorming and cross-country piling up time. They're going to begin breaking into the 1,000-hour class before long—and they'll soon be supplying the demand as fast as it is created. This business is a mushroom. A year from now, conditions will be entirely different. It won't be long before there will be plenty of pilots for the big passenger ships. You kids had better snap into it!"

I, for one, had no immediate desire to fly a ship carrying twenty-five passengers. I want to have a full 1,000 hours behind me before I take that responsibility. I had lain awake nights thinking about it. Getting lost in fogs! Running into terrific storms! Having engine trouble with no landing field in sight! Yet the growing perfection of modern ships and of engines is minimizing all such perils. The old-time flyers never knew when a motor would go bad and force them down. Now a flyer, like an automobile driver, can almost forget his motor.

I have made thorough inquiries to ascertain how much I may expect to earn as a commercial flyer. No fixed scale of wages has yet been established—so chaotic is the industry still! Some air lines pay more than others. Wages vary in different parts of the country. I learned, however, that:

AIR mail and transport pilots are paid like locomotive engineers, so much base pay plus so much "mileage." $75 to $100 a week, plus $5 an hour for day flying. $100 to $150 a week, plus $10 an hour for night flying.

An expert pilot employed as an "air chauffeur" by a wealthy plane owner receives from $100 to $150 a week. One pilot I know is receiving $200 a week on a yearly contract, but his case is exceptional.

For cross-country flying, a pilot is paid $10 an hour for the first five hours and $5 an hour thereafter, and can earn upwards of $5,000 a year. Some of the famous flyers will not go up for less than $15 an hour.

An instructor can earn from $3,000 to $6,000 a year.

A pilot delivering a ship from coast to coast is paid $350.

My early dreams of becoming a sky writer are probably doomed to disappointment, because in sky writing, flying becomes a fine art. Only two or three men in America have been considered good sky writers.

Pilots are in growing demand for express routes, air mail and express feeder routes, aerial photography, and aerial crop spraying and dusting, and can earn from $4,000 to $7,500 a year.

Barnstormers can still make as much as $5,000 a year taking people up for joy rides.

For some of these services, a flyer does not require a transport license. Entering them gives him an opportunity to "pile up" hours until he can command one of the big jobs.

AFTER that solid week of rain, the sun came out and with it came a high, dry wind. In two days the field dries out. The next morning "Chic" Gaver, the school manager, asked Randy Endow to fly over to the practice field and report on its condition.

Randy asked me to go along. We went in a three-place cabin plane, a Robin. Randy climbed it to about 2,000 feet. Then he cut the motor and said: "See that little patch of brown grass down there?" I peered down. It looked no larger than an automobile robe. He said: "Spot landing!"

Straight down into a glide went the Robin. At 850 feet, he banked the Robin over on her right wing until her nose headed straight for the patch of brown grass. Down we went in a long, steep side slip. Randy straightened her out of the slip and came down behind it. He leveled off and dropped the ship on the patch of grass without a bounce. Will I ever make landings like that?

The motor roared again. We flew low over the field while he inspected it—not more than five feet above it. The ground went by faster and faster. I watched

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Learn to Fly with Larry Brent

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the air speed indicator. It climbed: 70—80—90—95! Still we flew within five feet of the ground. Back came Randy's stick. Up we zoomed. When he straightened her out, the altimeter read 300! "Some zoom!"

"Grab her!" said Randy. I took the duplicate controls. It was my first experience at flying anything but the light, sensitive training planes. This was fun, and it was easy. The Robin didn't leap or tilt at the slightest touch. It was steady and solid.

Randy landed her and reported to Chet Gaver that the practice field was O. K. Half an hour later, Randy and I were back in the air in a training plane, soaring toward the practice field. Once again my instructor sat with hands folded behind head. I was going to make more landings.

"THIS time," Randy had warned me as we climbed aboard, "I won't touch anything—throttle, stick, or rudder. Keep your head when you level out."

I circled the field into the wind. At about 1,000 feet I cut the motor and went into the glide. The wind whistled in the wires. It sounded too low to me. I was making too thin a glide. I touched the throttle—cut it again. Was my glide correct for meeting that imaginary line down the center of the field? I began to level out. Would I make it this time? Or would I bounce or pancake?

The left wing began to drop a little. I corrected that as the ground came rushing up to meet me. There was a gentle jar on the left side, followed by a gentle jar on the right, then a gentle jar from the tailskid. I had made a fair landing—not on three points, but passable. Randy turned around and said: "Do it again!"

I took off and did it again. The next landing was a little better, but not yet on three points. I took off and tried again. Again the left wing sagged and the left wheel touched first, but I was getting the feel of it.

I made eleven landings one after another. Some were better than others, but all were fair. The last one, perhaps by pure luck, was a perfect three-pointer! Randy turned around and said:

"Keep it up and I'll be turning you loose any day."

That meant solo. I tried to appear indifferent although I wanted to yell.

But before I solo, I want some tail spins. I want to know how to pull a ship out of a spin.

Every day brings Larry closer to the thrill of that first solo flight. Tail spins next! Watch for another of his absorbing stories next month.

Catch Giant Turtle More than 300 Years Old

A GIANT 1000-pound turtle, believed to have been alive when the Pilgrim Fathers landed at Plymouth Rock, was hauled recently from the Gulf of Mexico. After its protective shell had been injured, possibly by a ship's propeller, it blundered into a fisherman's net. Four horses had to be hitched to the net to pull the struggling turtle ashore.

These big reptiles are remarkable for their length of life. One turtle is known to have lived 330 years. Even after the brain has been destroyed, life seems to linger for some time in the body. It is reported that a headless tortoise has been observed to walk 200 yards after decapitation. Other experiments have shown that if a turtle's heart is removed and suspended in a moist chamber, it remains capable of beating for two or three days.

What Rockefeller Has Done for Me

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Hundreds of weakened negroes and poor whites were awaiting treatment at this thoroughly equipped medical center typical of the hookworm stations that dot the southern states. A young doctor specially trained by the Rockefeller Bureau of Public Health gave my "tracker" patient a dose of carbon tetrachloride. This drug has been proved, after long experimentation by Rockefeller research men, to be the most effective vermicide that science can employ against hookworm.

After three months of treatment, during which time my friend began to look like a human being a few simple rules of sanitation were explained to him. He carried these ideas among his people, with the result that the soil was no longer contaminated, and the chief source of the hookworm was cut off. Two years afterwards, new hookworm cases in that county were nonexistent. The old cases were being successfully treated by the county doctors and nurses supported by Mr. Rockefeller's money. And today, barely fifteen years after the first shot was fired against hookworm, an examination of school children in eighty-eight southern counties shows that the disease has decreased ninety-four percent since 1909.

THE economic regeneration of the South is largely due to the fact that John D. Rockefeller's drive against hookworm enables southern children to grow up straight and intelligent, instead of stunted and unbenible.

Twenty-five years ago, the very name of yellow fever was enough to plant terror in the bravest heart. As late as 1911, a flare-up of this dread disease in South America killed 230,000 people in a single epidemic. But in 1927 *only three cases of yellow fever were reported in both Americas!* As a result of John D. Rockefeller's thirty-million dollar campaign, yellow fever is practically extinct in the western hemisphere.

Yellow fever as a world menace first came home to me when a college classmate, traveling in Cuba, was stricken and killed within four days by this fatal germ. A *stegomyia* mosquito—the fatal germ carrier—bit him—and that was my friend's death warrant. This happened only a few years before the World War, when the risk of contracting yellow fever had been greatly reduced by the excellent work of General Gorgas and the first Rockefeller Commission. But today one could safely pass through the tropic jungles of Central America without much fear of meeting the dread *stegomyia* mosquito. Intensive "clean-up" campaigns have resulted in the draining of swamps and pools where the mosquito breeds.

THE *stegomyia* is a domestic insect, and can be quite easily killed off merely by a few simple rules of domestic hygiene. But if a *stegomyia did* happen to bite you, the serum discovered by Dr. Hideyo Noguchi, a brilliant Rockefeller scientist, would save your life.

And now that the yellow fever has been eradicated in the western hemisphere, the Rockefeller Foundation is turning its attention to the African variety of this same disease which still runs rife along the Gold Coast. Only last year, Dr. Adrian Stokes, one of the most promising young scientists in the Rockefeller service, sacrificed his life, as did Dr. Noguchi, while investigating the African yellow fever. John D. Rockefeller said when told of Dr. Stokes's death, "It takes more than money to stamp out epidemics. My part of the job is less important and far less dangerous than the role played by such heroes as Dr. Stokes and Dr. Noguchi. I regret their deaths terribly, but I cannot help taking a solemn pride in the fact that the Rockefeller Foundation lists a long roll of scientist heroes who have died in the first line of the great war against disease.

When the Mississippi River decides to overflow its banks, there isn't much that can stop it. In 1927 the Father of Waters devastated 20,000 miles of farm land, drove 750,000 people from their homes, drowned 250 of them, and made mischief generally to the tune of $330,000,000. But there was one happy feature of the 1927 flood. There were no epidemics of typhoid, diphtheria, or dysentery—the three black horsemen that usually ride in the wake of a major flood. I was covering the flood story for a chain of newspapers, and expected to report any minute that a serious epidemic was raging among the refugees. But fortunately I didn't have to make any such report, even when the water began to retreat—which is usually the time that typhoid and diphtheria begin to rear their heads.

WHY didn't these stalking terrors break loose? Simply because the Rockefeller Foundation, in preparation for just such a catastrophe, had established hundreds of field hospitals along the Mississippi Valley. As soon as the storm broke, the Rockefeller hospitals wheeled into action. In conjunction with the Red Cross, which fed and housed the refugees, the Rockefeller doctors inoculated 200,000 school children against diphtheria and typhoid. A perfectly trained staff of nurses and doctors distributed medical supplies among the homeless refugees, and urged that the rudiments of sanitation be observed, even when the flood was at its height. The Foundation spent $2,250,000 in three months, protecting the flood victims from epidemics, and when the devasted areas were habitable again, more millions were poured into the task of educating the Mississippi Valley dwellers in methods of health preservation. President Hoover, who at that time was personally directing the rescue work, said to a group of newspaper men,

"Gentlemen, this flood is the worst I have ever seen—but without the preventive medical assistance of the Rockefeller Foundation, I think it would be one of the greatest disasters in the history of the world."

THERE is a little group of diseases which used to be a real menace to the duration and enjoyment of human life. Anemia, diabetes, and acute rheumatism used to claim 118 victims out of 10,000 population—until Mr. Rockefeller set his research men to the problem of eradicating this dangerous trio. Not only did they cause death, but were the cause of untold suffering to persons afflicted with them. The mental state of a pernicious anemia sufferer is one of acute melancholia, while the sluggishness of a diabetes victim is proverbially painful. If you ever have had a member of your family afflicted with anemia or diabetes, you will appreciate the boon conferred on humanity by the Rockefeller scientists who have learned how to control the course of these two malignant diseases.

Incidentally, both are treated with the by-products of two domestic animals. Insulin, the only successful agent in the control of diabetes, is derived from an ordinary pig; while anemia is effectively checked by an element found in calves' liver. In the Rockefeller Hospital, which is an important adjunct to the Institute for Medical Research, both of these diseases are being successfully treated and studied. Up to the present, the Rockefeller doctors have reduced the death rate from diabetes and anemia twenty-eight percent, and have greatly decreased the suffering attendant upon acute rheumatism and nephritis. Thus, in the case of four specific diseases, John D. Rockefeller has made life "happier and

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What John D. Rockefeller Has Done for Me

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longer" for anyone who happens to be suffering from them.

Heart trouble" is not as romantic as the Valentine verse writer would have us believe. Formerly there wasn't much hope for a person with a defective heart valve or abnormally high blood pressure. "Apoplexy," as it was called, used to whisk them off in a split second. But thousands of potentially apoplectic persons are being reclaimed by the surgery of Dr Alexis Carrel and the treatments of Dr H J Stewart. Carrel's technique has been used successfully on the defective valves of a thousand human hearts, while Dr Stewart has devised dietary and medicinal remedies for abnormal blood pressure. Day after day these men work quietly in the Rockefeller laboratory, originating new cures for that most undesirable form of death—heart failure.

SUPPOSE you are a young Middle Westerner with university ambitions that cannot be satisfied by various small colleges scattered throughout your section of the country. As a prospective student of law, medicine, engineering or theology, your interest naturally gravitates towards the University of Chicago, the third largest institution of learning in the United States. Its faculty of learned scholars, its academic equipment housed in thirty-five huge buildings, including the famous Yerkes Astronomical Observatory and its huge endowment of thirty million dollars, enables you to pursue your studies in whatever field of knowledge you choose, and emerge as a leader in your profession.

But if it were not for John D. Rockefeller, there wouldn't be any University of Chicago. The massive buildings now standing on the shores of Lake Michigan are the result of his original endowment of eleven million dollars in 1892, followed by twenty millions in gifts since that time.

"I intend to give the Middle West one of the finest universities in the world," was Mr. Rockefeller's statement as the cornerstone of the University library was being laid. And he is living just about what he intended to do. During the last thirty-five years, more than 300,000 students have passed through the doors of Mr. Rockefeller's University into a world where their skill and knowledge have immeasurably benefited both society and themselves. If Mr. Rockefeller never did anything else, he would still be the recipient of unmeasured gratitude from thousands of men and women educated at the University of Chicago.

FAR from Lake Michigan's shores stands another college of which Mr Rockefeller is the founder and chief patron. If you ever visit Peking you will find on the site of what was formerly the palace of a Chinese prince, a group of beautiful buildings combining the best features of classic Chinese architecture and American scientific construction. These buildings are the Peking Union Medical College, built, equipped, and maintained with funds supplied by John D Rockefeller through the agency of the China Medical Board. In its laboratories and clinical wards, healing and research are being carried on by seventy-eight doctors, many of whom are Chinese, educated in Europe and America on Rockefeller Medical Fellowships. These doctors are exterminating leprosy, small pox, and tuberculosis, three diseases that have raged in China for untold centuries. Until 1914, the Chinese government viewed these epidemics as a matter of course. A missionary friend of mine was horrified to hear a high Chinese official say: "Oh yes, a million of our people will die from leprosy this year, just as they have died every year since the building of the Chinese Wall." In 1914, however,

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What John D. Rockefeller Has Done for Me

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ever, John D. Rockefeller sent a commission to China to see what could be done for the backward yellow race. The members of this Commission fearlessly penetrated into the interior of China, risked their lives in meeting the hazards of banditry and disease, and made a monumental report to Mr Rockefeller, in which they strongly recommended that he establish base hospitals in Peking, Tientsin, Shanghai, and Canton.

BARELY a decade has passed since these hospitals began their labors of educating and healing 400,000,000 Chinese. But already, deaths from leprosy have been reduced nearly 45 percent. The lepers are now segregated and treated with chaulmoogra oil, which is an effective cure in the early stages of the disease. Dietary conditions among Chinese peasants have been vastly improved by the introduction of potatoes and green vegetables. Standards of sanitation are constantly ascending, which is the first step in the struggle against all disease. In addition to treating patients at the base hospitals, the China Medical Board contributes generously to the support of outlying missions and field hospitals. My missionary friend has often told me that his work could not possibly go on were it not for the financial and practical help he gets from branch of John D.'s humanitarian treasury.

Does Mr. Rockefeller ever give money to "ordinary poor people?" He most assuredly does. For many years the Laura Spelman Rockefeller Memorial, fund established by Mr Rockefeller in memory of his wife has been a tremendous force for good among the American poor. Individual poverty is relieved and sickness stamped back to health by means of this fund, the extent of which is not made public, for obvious reasons.

John D. Rockefeller has been called many hard names, but I forgot all about them when I examined a recent Annual Report of the Foundation bearing his name. It is a 500-page book, jammed with facts and figures in which old John D. gives an account of his stewardship. I select a few passages at random, to illustrate the scope and variety of uses to which the Oil King's money is being put:

2,018 sanitary latrines erected in Colombia.

370,421 hookworm treatments in Panama.

Malaria death rate reduced 60 percent in Argentina. 32 Public Health Fellowships granted in China. "20,005 antidiphtheria and 19,000 small pox vaccinations in Louisiana." "Summary of expenditures for the year—$19,700,372."

AND behind all this humanitarian activity, in which I feel myself to have benefited either directly or indirectly, is the personality of John Davidson Rockefeller. In spite of his eighty-eight years of age, he is still the dominating force in the world-wide campaign against disease. It is his ambition to pour the larger part of his wealth back into the service of his fellowmen and it seems likely that he will succeed in this high objective. His philosophy is contained in the few words on the seal of the Foundation, "The Wellbeing of Mankind throughout the World."

"But," you ask, "how about the thin dimes he gives to his caddy, his newsboy and to the reporters who interview him on the subject of his wealth?"

Well, I suspect that Mr Rockefeller is a humorist. Or so it seemed to me, when, at the conclusion of a friendly chat in Florida last winter, he said, with a twinkling eye:

"I rather like your way of interviewing me for POPULAR SCIENCE MONTHLY. I want to do something for you." He thrust a long finger into his vest pocket and smilingly handed me not one, but *two* bright new dimes.

"We never dreamed we could afford it"

MANY people have denied themselves the comfort of Electrol automatic oil heat because of the mistaken idea that Electrol was beyond their means.

The error is a natural one . . . due in part to the widespread preference for Electrol among those to whom cost does not matter, and due also to the impressive praise accorded Electrol by users everywhere.

Electrol owners agree that its price is much lower than they expected to pay . . . that its higher fuel efficiency and longer, trouble-free service make it the outstanding oil burner value on the American market.

Entirely automatic and employing electric ignition, Electrol provides constant comfort, thermostatically regulated. Governed in every phase of its quiet operation by the exclusive *Master Control*. Sizes for every home, large or small. Convenient terms, if desired. May we send you descriptive literature?

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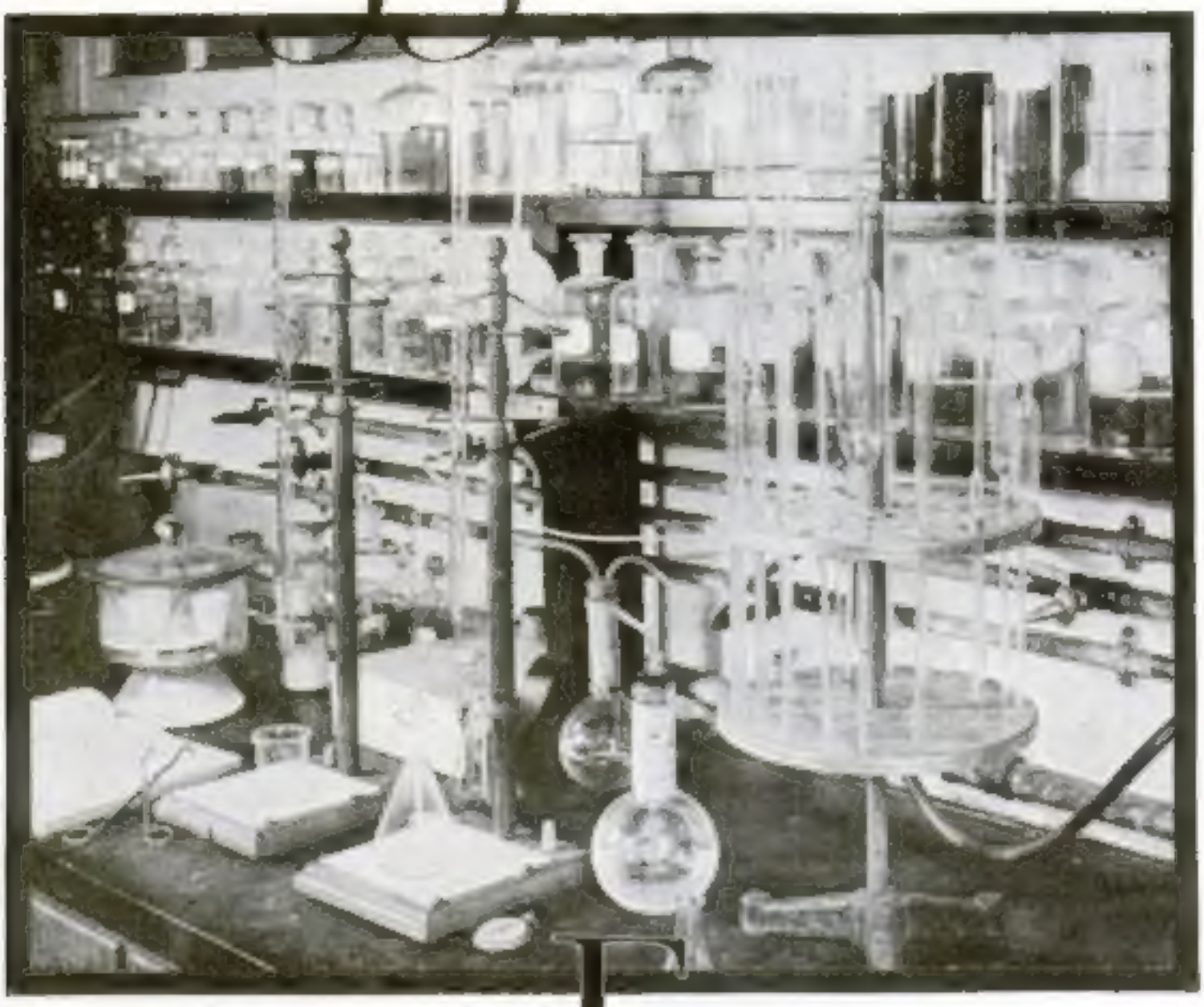
ELECTROL

The OIL BURNER *with the Master Control*

Listed as standard by the Underwriters' Laboratories

This seal on an advertisement in POPULAR SCIENCE MONTHLY signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

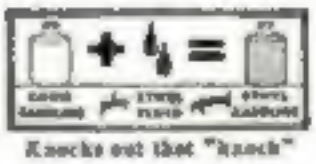
Out of 33,000 compounds came ETHYL GASOLINE



IN the long years of research and experiment which led to the discovery of Ethyl fluid, some 33,000 chemical compounds were tried.

The problem was to find something which, when mixed with gasoline, would control its combustion rate as the compression of the engine was raised. Ordinary gasoline explodes too fast—"knocks" and loses power—when compressed beyond a certain point. If engines of higher compression were to be practical commercially, some way had to be found to adapt gasoline to the demands of high compression.

Finally it was found that Ethyl fluid, the active ingredient of which is tetraethyl lead, kept the combustion rate steady, eliminated "knock," and enabled an engine to develop all its power as the compression ratio was raised.



Knocks out that "knock"

This was one of the greatest forward steps in the history of the automobile. It made possible engines of higher compression. It brought out of engines of average compression, additional power impossible to obtain with ordinary gasoline.

Today leading oil companies mix Ethyl fluid with their gasoline to form Ethyl Gasoline. It is used by hundreds of thousands of motorists in cars of all ages and types. Each Ethyl user will tell you that Ethyl has created a new standard of motoring comfort and efficiency.

Start riding with Ethyl today. You will see the difference it makes.

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Back of this monogram are the accumulated experience and skill of the world's largest organization engaged in the manufacture of electrical materials and appliances. Always and everywhere it is a safe guide to electrical quality and dependability.

THE chief operating requirement of the General Electric Company, and of the electrical industry in general is not horsepower, but brain power.

This requirement must be continuously anticipated. The leaders of the future must not only be born, but *made*. Accordingly, the General Electric Company maintains at Schenectady and elsewhere a post-graduate college of electrical science which has achieved a unique position in the engineering world.

The faculty includes inventors and engineers of international distinction and authority. The students—more than 400 of them are enrolled every year—are the picked graduates of the best-known American and foreign technical schools and universities. The graduates provide not only this Company but the electrical industry in general with many of its most valuable leaders.

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"I'd walk a mile for a Camel."

"So would I."